8 JUNE 1961

ONE SHILLING AND SIXPENCE

ELECTRICAL TIMES

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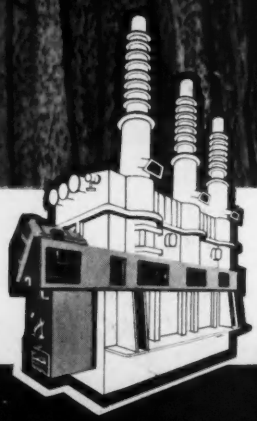

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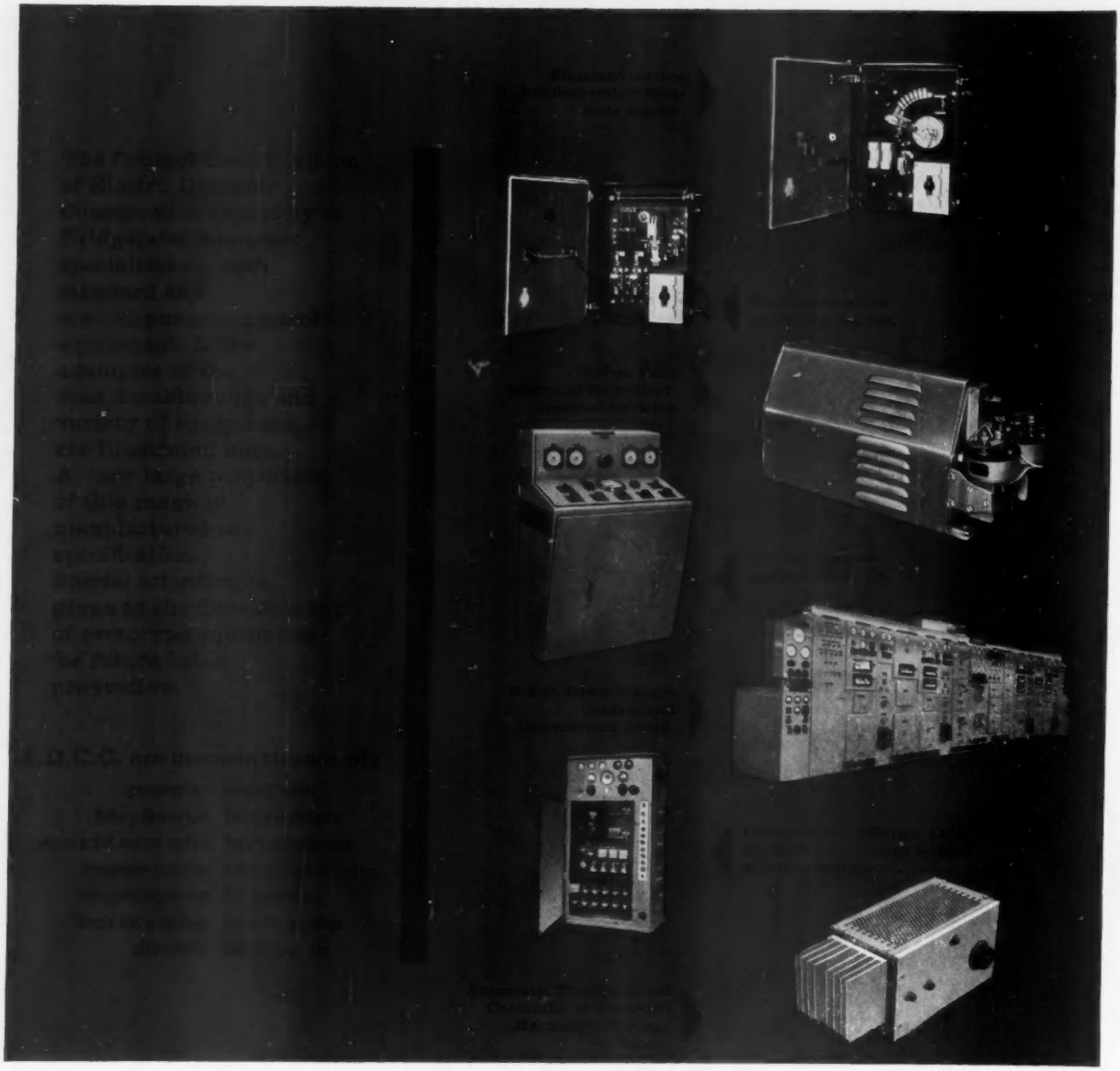

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CONSTRUCTION COMPANY LIMITED

ST. MARY CRAY ORPINGTON KENT TELEPHONE: ORPINGTON 27551 TELEGRAMS: ELEDAMIC ST. MARY CRAY

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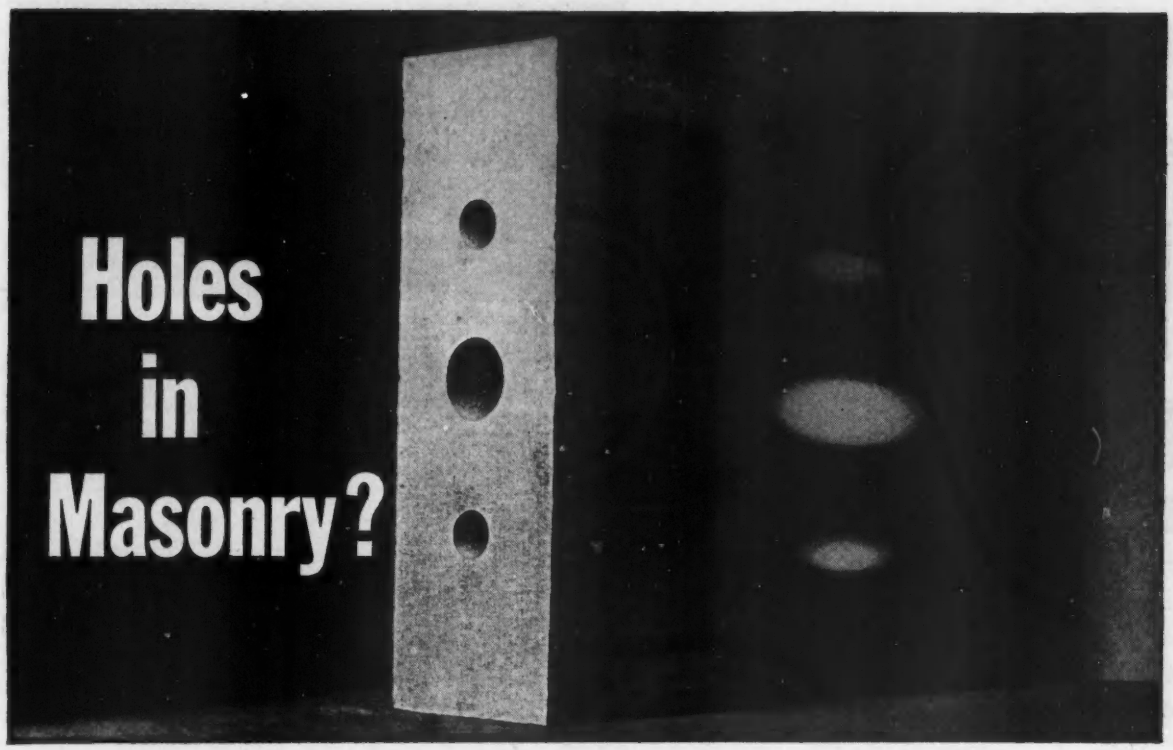


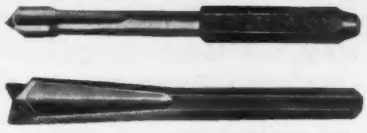
It's far quicker with RAWLPLUG TOOLS

The outstanding quality and endurance of Rawlplug Hole Boring Tools save their cost over and over again in speedier, more accurate work and longer life. Whatever the job—few holes or many—these are the Tools that are most economical in the long run. And with Rawlplug Tools that's a very long run indeed!

TOUGH, FAST-CUTTING TOOLS FOR DRILLING Brick, Slate, Concrete, Marble, Tiles, etc.

HAND TOOLS

For only a few holes, hand percussion tools may best suit your needs. They are of many sizes and types—Rawldrills and Stardrills (for brick, concrete, etc.). Wall Boring Tools and Tubular Boring Tools (for boring right through walls and ceilings).



DURIUM DRILLS

These Durium drills with their almost diamond-hard tip, give astonishing cutting performances in brick, tile, cement etc. They are silent in action, and have a patented rapid-helix flute which forces out spoil and prevents clogging. First re sharpening FREE!

VIBROTO DRILLS

With their special cutting angle metallic carbide tips. Vibroto Drills give spectacular performances in drilling concrete, etc., and other hard materials. They are used in the Vibroto Drilling Machine, which has two *vibratory* actions (Light Rapid and Heavy Slow), and also a rotary action for use with standard Durium-tipped Drills.

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HOLE-BORING TOOLS *For Speed and Endurance*

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RIGHTON SERVICE!

Our entire business has been geared to fit our customers' needs. That is why we always hold over 1,000 tons of material in readiness. And that is why when you buy from us, you are certain of Mill condition and an unparalleled delivery service.

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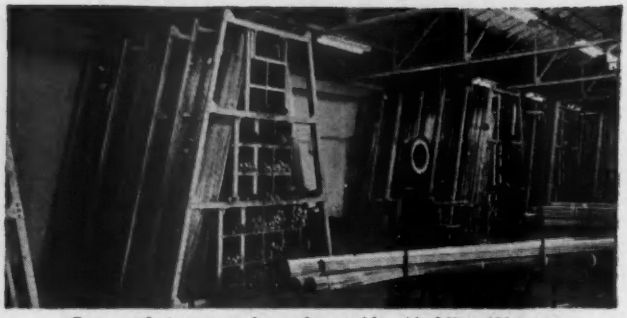
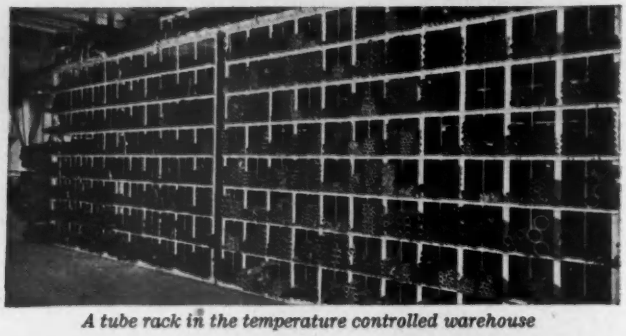
Aluminium Brass and Copper



Brass rod storage racks each capable of holding 100 tons



A tube rack in the temperature controlled warehouse

The heavy rod storage sections showing material stored in U frames for rapid handling

A strip and section rack with over 2,000 compartments

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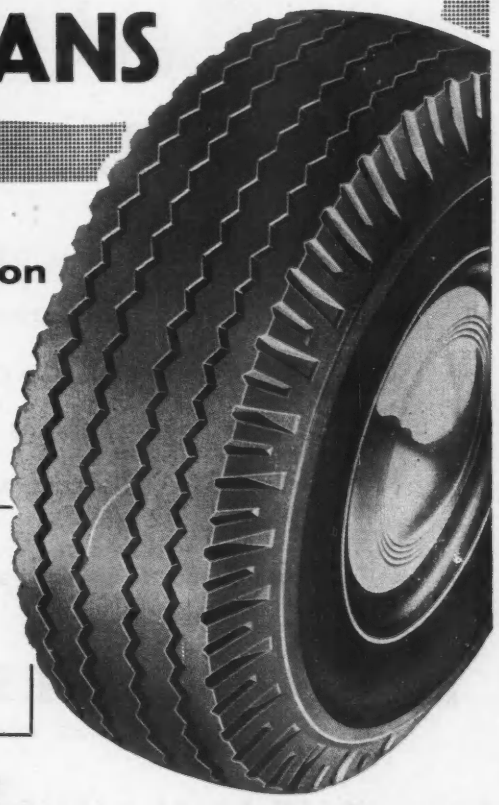
Firestone TRANSPORT TYRE

now available to reduce tyre costs on LIGHT VANS



Commercial truck tyre construction with deeper non skid pattern. Greater volume of tread rubber and stronger beads.

The famous **Firestone** TRANSPORT TYRE is available in the following light van sizes

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- Industrial and Marine Starters
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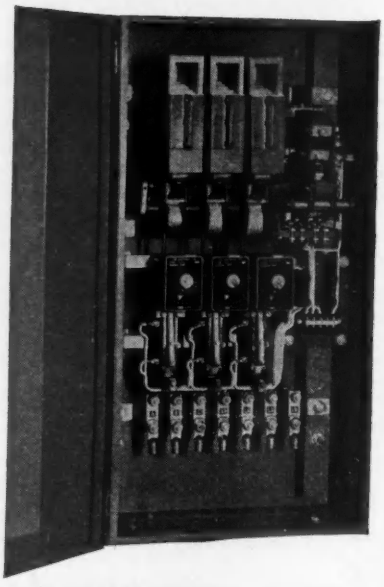

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Pressure die castings are inseparable from modern living and Wolverhampton Die Castings offer manufacturers high quality components at remarkably low cost in a variety of pleasing finishes. And the massive scale of production that can be achieved helps everyone to enjoy a higher standard of living.

Wolverhampton pressure die castings in zinc and aluminium point to progress in a big way. Your enquiries would be welcomed.

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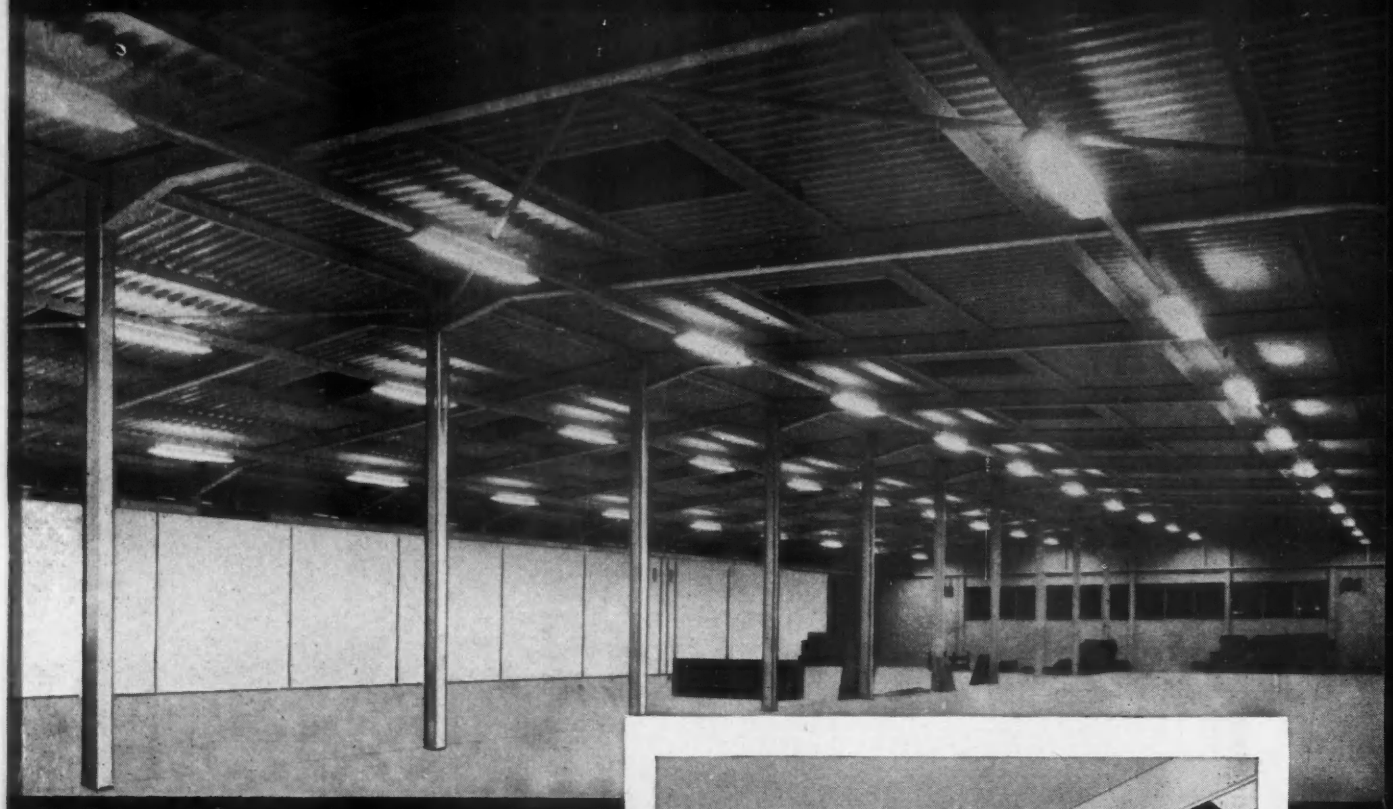

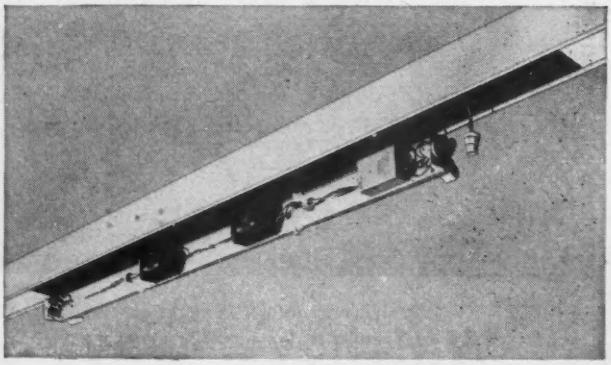

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—the answer in the long run

Benjamin Lighting Trunking reduces installation cost and maintenance to a minimum. The system gives real flexibility with simplicity of design. The stringent specifications include these features:

- Light in weight but immensely strong. Up to 15 ft. centres for suspension with maximum loading.
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- Easy installation. Joints and suspensions carry the load whilst securing bolts are tightened.
- Lighting units can be moved easily to any position.
- Simple fixing of all fittings and lamps. Easy access to cables, switches, plugs.
- Designed for 8 ft. and 5 ft. standard 'Taskmaster' reflectors and tungsten range.

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Whichever way you look at it, SANDACLAD Switchgear is 'just the job'. Perfect as can be in conception, design and manufacture it bears the unmistakable stamp of quality. From our point of view, SANDACLAD Switchgear —indeed, every Sanders product—embodies the best of modern techniques both in design and fabrication. For the electrician SANDACLAD Switchgear offers the simplicity of speedy, easy wiring and the elimination of time-wasting frustrating re-adjustments. And the user can have complete confidence in the capability of SANDACLAD Switchgear to perform its allotted task and to carry its designated loading. Dependable, reliable and as pleasing in appearance as such equipment can be, SANDACLAD Switchgear provides safe, immediate and lasting control of electrical power.

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NEWS SHEET

Sir Robertson King to retire from chairmanship of Electricity Council on 1 January, 1962; follows Sir Josiah Eccles retirement. R. S. Edwards present deputy, to become chairman. C. T. Melling promoted deputy on 1 August. (899, 915)

Contract conditions discussed at ECA conference as well as future technical developments. Use of indenter-jointing instead of screwing for steel conduit, more plastics conduit predicted. Lighting of offices reviewed; bare fluorescents in general, offend against latest IES code. (899, 906)

New passenger cars on Metropolitan line will increase seating capacity by 25%. Delivery of new stock to be completed by next year, will mark completion of modernisation programme. (928)

International Combustion bid to acquire Superheater Company in share exchange deal. Latter's directors recommend acceptance. (924)

Power from ocean waves for island colony of Mauritius is project now being investigated. Hydraulics laboratory study offers promise of 9,250 kW scheme and greater power later. Site tests now in hand. (900, 920)

Denis Ferranti purchase polyphase meter business of Parkinson Cowan, Measurement; will be complementary to own single-phase meter production. (924)

Up to 10% tariff reductions in N Ireland followed commissioning of Coolkeeragh power station with lower fuel cost of oil generation, says annual report of Electricity Board. (921)

Reclosures on charged lines gives high switching surges according to US power conference paper describing tests on miniature e.h.t. systems. Gas turbines as peaking plant is best long-term solution according to computer studies. (917)

NCB 1960 report shows sales up, stocks cut. Cost per ton output 2s up on 1959, despite fall in labour cost. Power station consumption 11·1% up on 1959. Overall consumption 8·8 million tons more than 202 million tons output. (912)

PEOPLE—E. V. Small (of AEI) joins Boving board . . . G. N. Walker elected new ECA president . . . A. M. Parsons to succeed T. B. Ellis (retiring) as GEC secretary, and C. S. P. Mallam becomes controller with B. E. Davey promoted chief accountant . . . T. Blythe joins Aircraft-Marine Products as general manager . . . In HMV domestic appliances division, A. F. Burton is general manager, H. G. M. Coleman, commercial manager, and W. J. Hume-Humphreys sales manager . . . A. H. Lowman succeeds J. Brocklebank as Western District manager, LEB . . . L. A. Thomas promoted chief physicist, GEC labs. (914, 916)

NEWS SHEET

Three types of internal stress control in cable terminations reviewed by Enfield-Standard Cables', S. C. Chu. Resistance grading doubtful beyond 230 kV, configuration of electrodes used up to 330 kV, but calculations difficult, capacitance grading satisfactory to 425 kV can be extended. (900, 901)

HMV to cut out wholesalers in distribution of domestic appliances, from 1 July, new EMI subsidiary will deal directly with retailers. Other subsidiary, Morphy-Richards, to continue to use wholesalers. (924)

Constant current control for diesel-electric propulsion used on new GPO cable ship *Alert*. System incorporating amplidyne exciters also used for cable handling machinery and bow propeller for maximum manoeuvring ability. (919)

High reliability direct-to-electricity energy converters include photovoltaic cells, mechanoelectric converters and fission cells. These may be suitable for small-scale use as in space research, not where efficiency is important. (909)

Submarine cable across Menai Straits suggested by Anglesey County Council at inquiry into Wylfa nuclear power project. Local MP criticises opponents to scheme. (927)

30% more meter production for Ferranti Ltd., will result from £200,000 modernisation scheme. New automatic transfer line for machining meter frames is main feature. (925)

Industrial use of electricity slows down in March quarter, show Electricity Council figures. Domestic consumption still 16% above last year. (924)

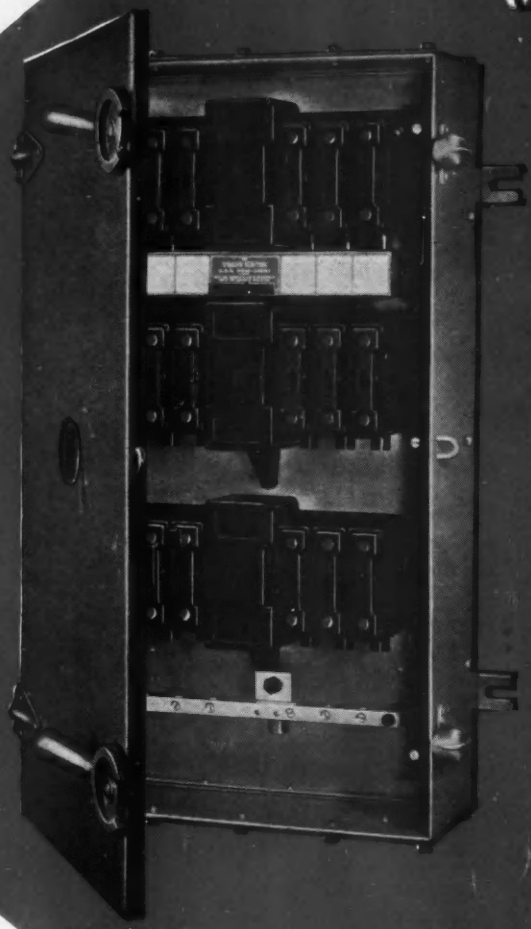
BUSINESS—English Electric sell half Napier aero engine interest to Rolls-Royce (929) . . . BICC acquire Bessbrook Products, N Ireland firm (924) . . . Drayton Regulator to change name to Drayton Controls . . . Johnson and Phillips restart dividends with 5% but record turnover produces small profit . . . Elliott-Automation earnings still rising and Stone-Platt report recovery . . . little change for Allen West, Crompton Parkinson, and Max Stone . . . £1¾ million loss by John Thompson, including £1½ million on Berkeley and drop in profit by Automatic Telephone shocks market. (932)

OVERSEAS—Pakistan sets up new Power Commission and to get DLF loan for Quetta power station . . . 64 MW hydro station on Pasvik River, Norway, planned . . . With £442,000 surplus, Electricity Corpn. of Nigeria anticipates continued progress . . . Impasse in BC on Columbia development plan . . . India may get less aid from USSR. (930, 931)

RED SPOT

Heavy Duty

FUSEBOARDS



500 volts
15, 30, 60
and 100 amps

Phase busbars and incoming cable sockets are enclosed in solid insulation. This feature coupled with the shrouding of fuse contacts and terminals permits spare ways to be cabled in safety while existing circuits are on load.

Full details are given in PUBLICATION FG/138.

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FG. 308

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KARIBA at 330 kV.

All the bushing porcelains for the 330 kV. circuit breakers
All the 330 kV. strain insulators for the substations
and the 330 kV. post insulators for some of the substations
by

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MAIN CONTRACTORS · AEI LTD.
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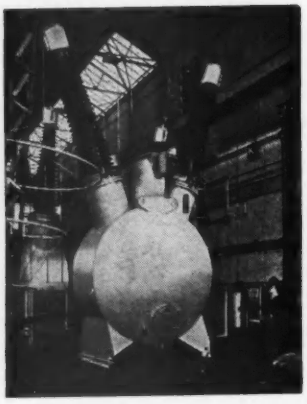

The illustrations show a complete 330 kV. bushing insulator and a 330 kV. circuit breaker, by courtesy of the AEI Ltd.

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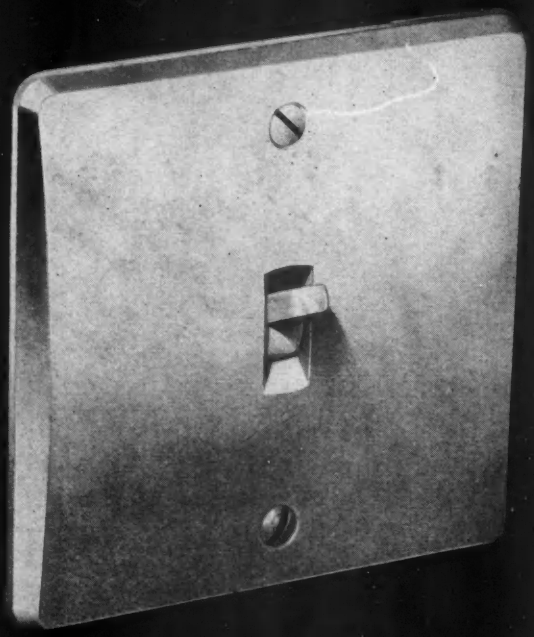
the switch that is silent...



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G.E.C. Installation Equipment Group have a *new approach* to switch design which serves to take the clicking out of switching.

If you listen hard enough you *may* just hear the discreet whisper of a 'Mutac Clipper'.

Furthermore, the *new approach* makes 'Mutac Clipper' switches unrivalled for ease and speed of assembly . . . ensures that these precision-made, electronically-tested switches give a guaranteed long-life performance.

G.E.C.'s *new approach* enables you to put one, two or three 'Mutac Clipper' switches in a standard BS1299 box. There's a choice of 44 different switch plates—in moulded plastic or metal—and 11 interchangeable units fit into just three different sized boxes:

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5 amp 1 way D.P.
5 amp 2 way S.P.
5 amp 2 way & off
5 amp intermediate
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5 amp 2 way secret
Bell Push
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Blanking Unit

'Mutac Clipper' switches cost no more than ordinary switches to buy and far less to install—that's a result of G.E.C.'s *new approach.* Complete interchangeability of 'Mutac Clipper' enables you to standardise right through a job.

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***IMMEDIATE DELIVERY** of all 'Mutac Clipper' switches from wholesalers throughout the country. If you would like more detailed information, ask your wholesaler for 'Mutac Clipper' literature.*

OUTDOOR SWITCHGEAR

FOR SEMI-HAZARDOUS AREAS

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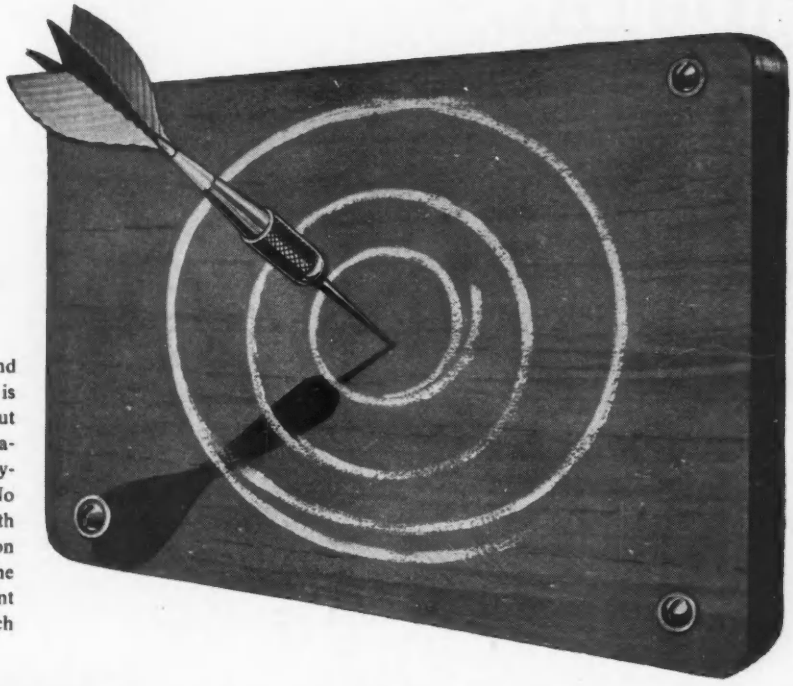

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Bound to . . . if they're Wootton-made . . . and Wootton-tested! Only the stoutest plywood is good enough for Wootton. Every piece is put to the test. For reliability, toughness, durability, Wootton meter boards stand up to anything. Even in the most extreme climates. No contraction or expansion or warping with Wootton! Oh, and there's more to Wootton than just meter boards. They're right on the target with wood blocks too, and instrument cases, and they're brilliant at sunk switch boxes.

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For local lighting in parks and gardens.

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'HIDUTAC' switchfuses pack more space into a smaller size

Radial positioning of the contacts of 'Hidutac' switchfuses allows a *unique compactness*. This is just one of many 'Hidutac' exclusive features resulting from G.E.C. Installation Equipment Group's *new approach*, based on many years' experience of making switchgear superbly well. The 60 amp. TPN 'Hidutac' measures only $13\frac{9}{16} \times 8\frac{1}{2} \times 4\frac{1}{2}$ in. yet there is still generous wiring space and easy access to the terminals at the front.

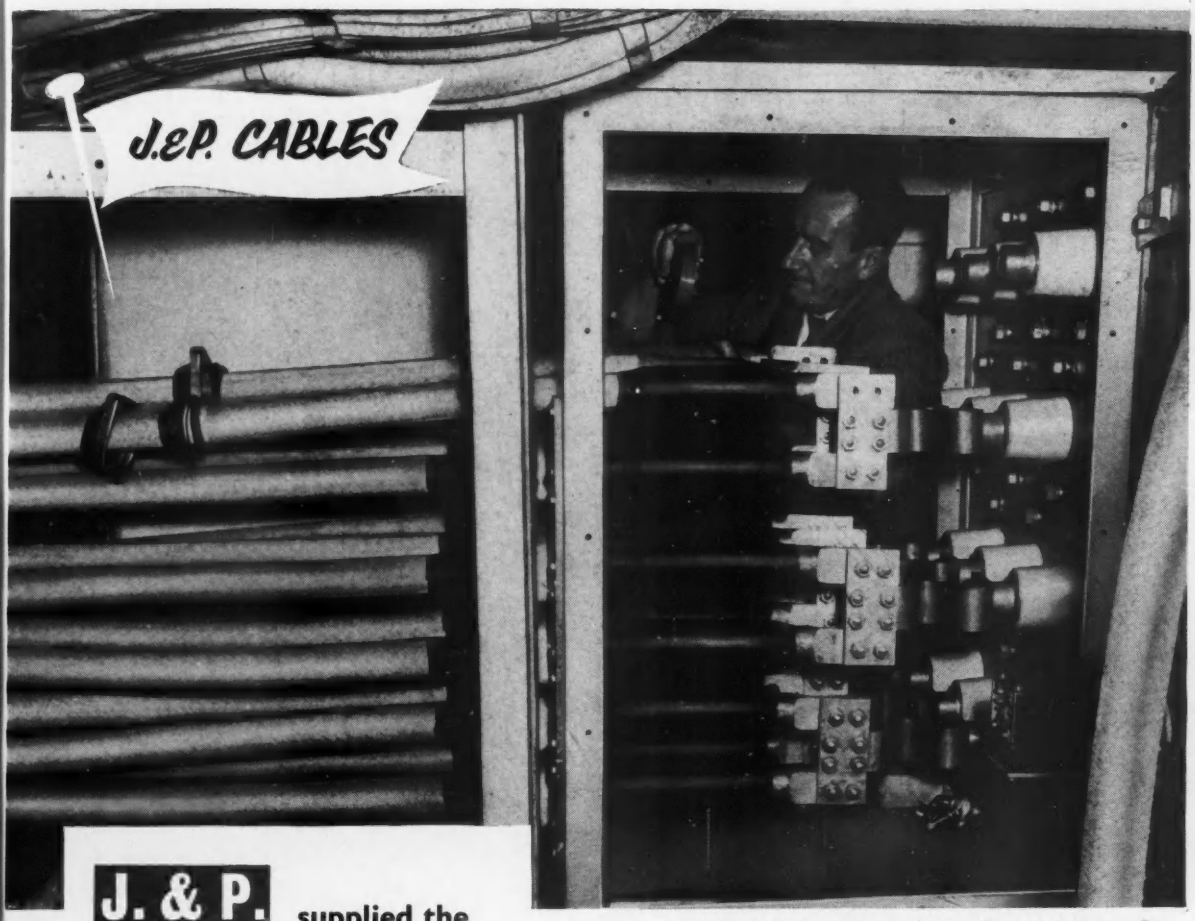
Consider these other impressive advantages: *Unlimited full load switching*—'Hidutac' switchfuses operate at their full load current with unfailing reliability. *High breaking capacity*—8 times the rated full load current—through cam-operated, double-break, silver contacts. *Total internal enclosure* of all moving parts, with shields over live terminals. *High fault current protection* in Single Pole and Neutral, Double Pole, Triple Pole, Triple Pole and Neutral switchfuses with H.R.C. or rewirable fuses. Categories of duty are: H.R.C. fuses, all ratings, AC4 of BS88 (33,000 amp.); rewirable fuses, 15 and 30 amp. ratings, S2A of BS3036 (2,000 amp.); rewirable fuses, 60 amp. rating, S4A of BS3036 (4,000 amp.). *Modern styling* of pressed steel case with fully interlocked cover.

These exclusive features make 'Hidutac' switchfuses vastly superior for tungsten and discharge lighting control, motor control, and transformer and capacitor switching.

***IMMEDIATE DELIVERY** of 'Hidutac' switchfuses from wholesalers throughout the country. For more detailed information ask your wholesaler for 'Hidutac' literature.*

that's the New Approach of G.E.C.

INSTALLATION EQUIPMENT GROUP



Jointing the propulsion cables on the P & O/Orient Liner 'Canberra' built by Harland & Wolff Ltd., Belfast.

J. & P. supplied the

6,000 V propulsion cables for "CANBERRA"

The main propulsion cables of the Canberra's turbo-electric installation, which develops 85,000 shaft h.p., were made by J. & P. The cables are required to operate at 6,000 V on a three-phase system, and it is the first time that an operating voltage as high as this has been used on a passenger ship. Owing to the vital role the cables play, J. & P. were called upon to undertake the jointing.

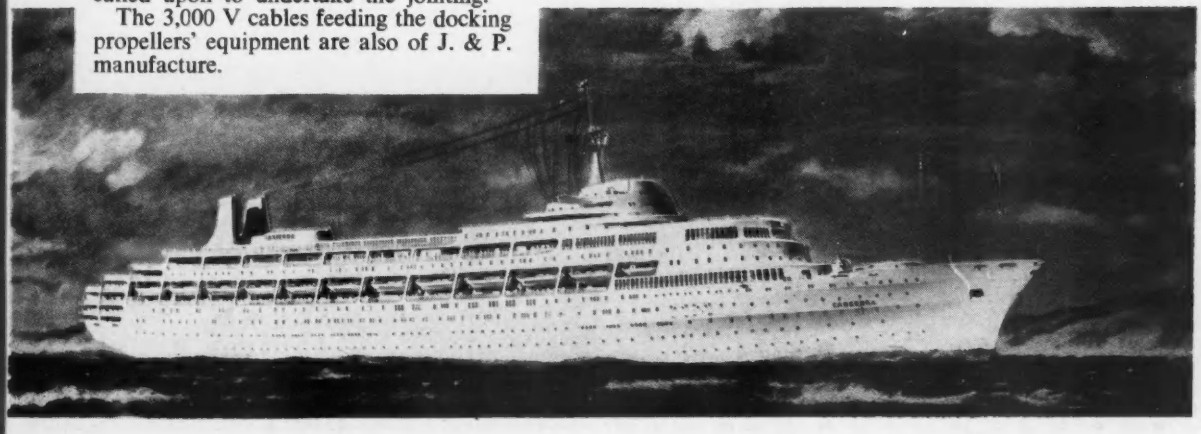
The 3,000 V cables feeding the docking propellers' equipment are also of J. & P. manufacture.

JOHNSON & PHILLIPS LTD.

CHARLTON · LONDON · S.E.7

Electrical Engineers and Cable Makers. Established 1875

Overseas Factories in AUSTRALIA, SOUTH AFRICA, PAKISTAN and INDIA



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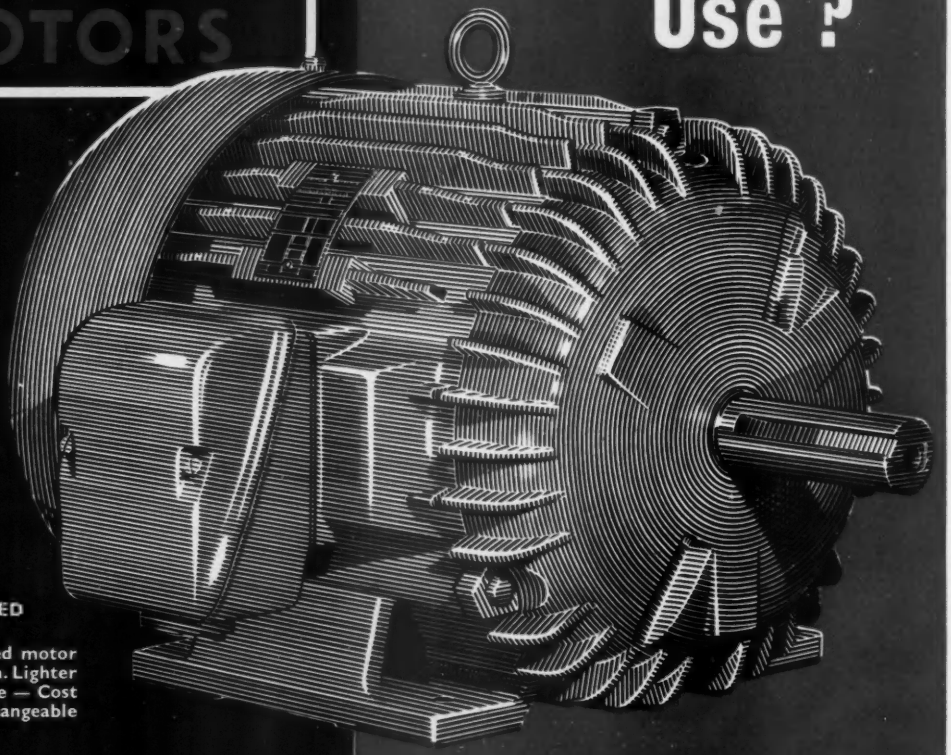
Which Motor Should You Use ?



TOTALLY ENCLOSED FAN COOLED

'D' Type Standardized motor with class 'E' insulation. Lighter weight — Smaller size — Cost saving — Fully interchangeable for fixing dimensions.

BROOK MOTORS LTD. HUDDERSFIELD

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from 1/25th. to 600 horsepower

THE MOMENT OF DECISION

- Deciding which electric motor to buy is not the easiest of tasks ... but careful selection pays in higher efficiency and lower maintenance cost.
- There are literally thousands of variations in horse power, speed, enclosure and electrical characteristics. Each combination of features making the right motor for a particular type of work.
- Brook have listed many of these variations in a new publication, which contains helpful information on all aspects of electric motor application and detailed instructions for ordering.
- You can have a copy of this profusely illustrated booklet by sending the coupon at the left hand corner of this advertisement. Post it now!

WHY BROOK?

- Because all basic materials are tested in their research laboratories .... all components are machined on modern plant ...all parts and sub-assemblies are carefully inspected.
- Brook motors run cooler, they are designed to run on full load below the Standard temperatures, giving *extra* overload capacity.
- Brook products are supplied with all the technical assistance you need, either before you buy or afterwards. Service and spares are available in almost every country in the world.

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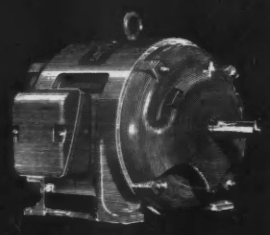
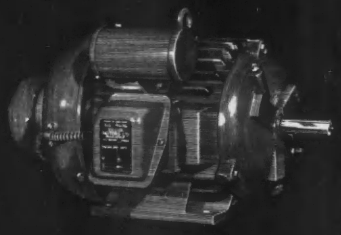
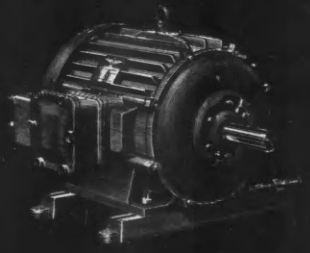


DRIP PROOF
'C' type motor to B.S.2960. For all normal driving applications.



SINGLE PHASE CAPACITOR
Available in T.E. Fan Cooled (as shown) or in Drip Proof enclosure. Both types have a robust, easily accessible centrifugal switch.



FLAMEPROOF
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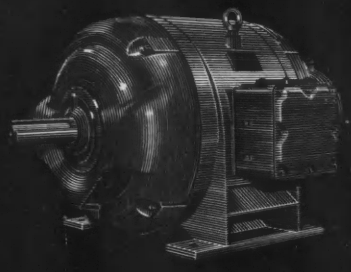

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Cage or slip ring types in larger Drip Proof frames are made up to 600 h.p.

T.E. Fan Cooled motors are offered up to 275 h.p.

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There are many applications in electrical engineering where a combination of light weight, ductility and good electrical properties offers obvious advantages. Already, aluminium is being widely used for conductors and structural components. Applications range from busbars to radio and television chassis, from cable sheathing to fan blades, from transmission lines to thermionic valve screens. And remember that many direct uses of aluminium bring important secondary economies.

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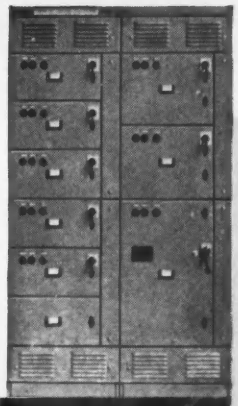

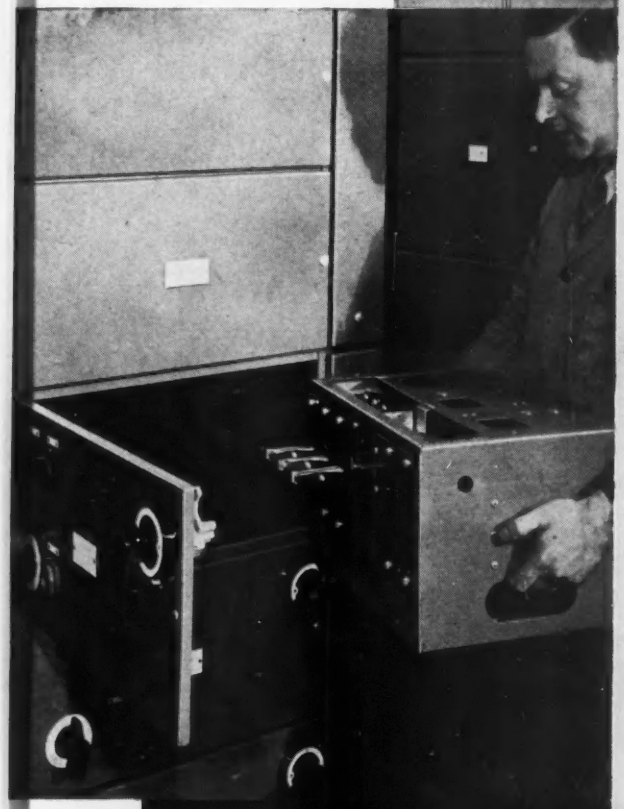

ONLY THE G.E.C. MOTOR CONTROL CENTRE IS SO COMPACT SO EASY TO INSTALL

- Starter trays can be unplugged, withdrawn and replaced after cubicle shell is in position
- Starters up to 200 h.p. at 550V and 150 h.p. at 400 V can be included as a standard feature, and matching equipment of unlimited range can be supplied
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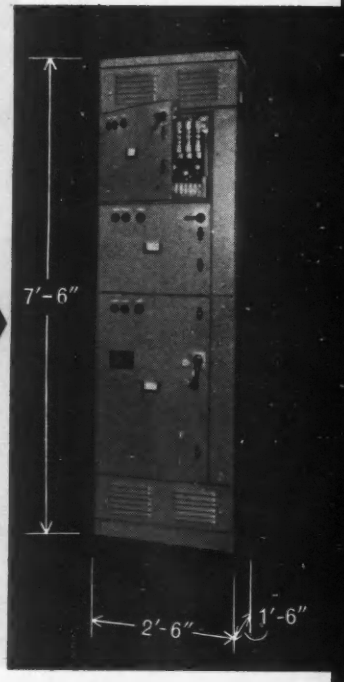
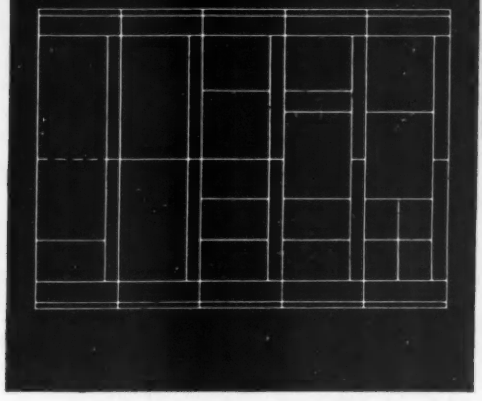
- 18" deep cubicles save space
- Designed around a number of basic starter sizes to make the most use of space and give flexibility. (One vertical cubicle section will accommodate 12 starters up to 7½ h.p. or 6 starters of up to 15 h.p.)





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All starter units are interchangeable

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Within 12 to 16 weeks of order

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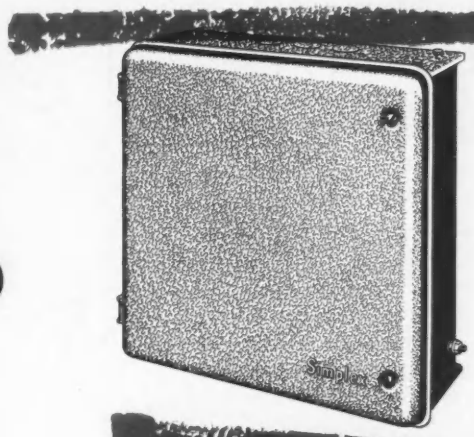
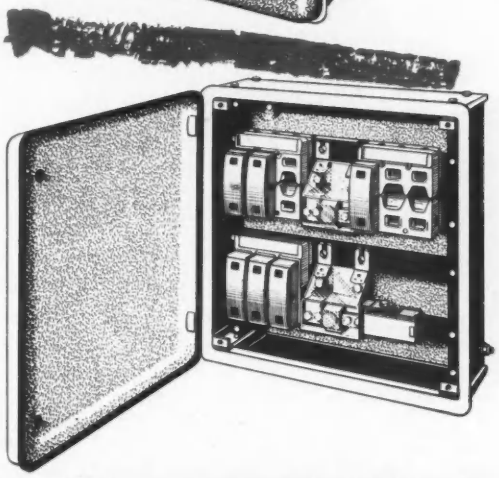


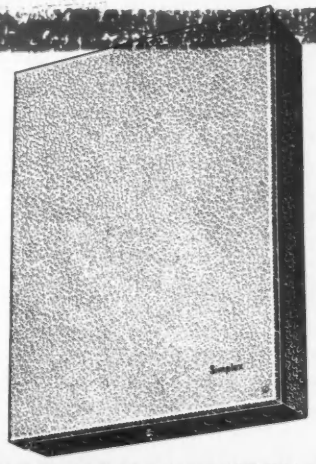
Star Distribution Fuseboard. Neat appearance. Strong All-Steel case.



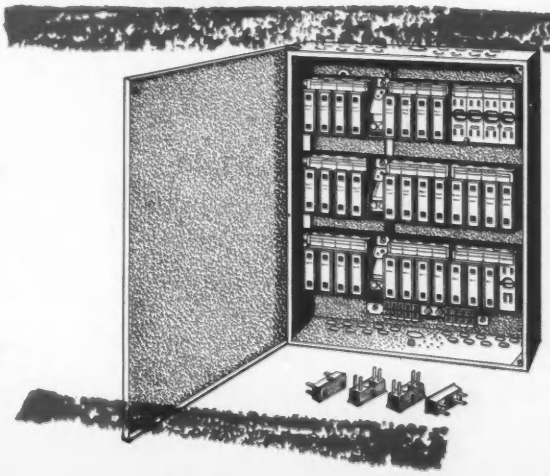
Star Distribution Fuseboard with cover open; some fuses are removed to show dead-front feature.

DISTRIBUTION FUSEBOARDS

Simplex Star "dead-front" Distribution Fuseboards are: low in price · easy to wire · completely safe because all live parts are shrouded, even with the fuses removed. There is provision for: circuit indentification on the fuse bank and neutral connections · surface or flush mountings. Ratings — 15, 30 or 60 amp, 500 volt A.C. or 250 volt D.C. Star Economy Distribution Fuseboards offer the same advantages as the Star Distribution Boards at the lowest possible price. More details of Simplex Star Distribution Fuseboards available on request.



Star Economy Distribution Fuseboard.



Star Economy DistributionFuseboard with cover open showing shields, and dead-front feature when fuses are removed.

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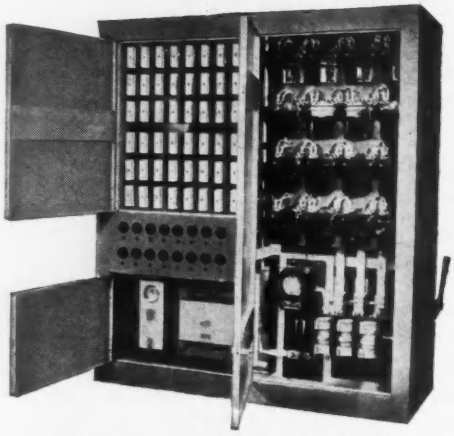

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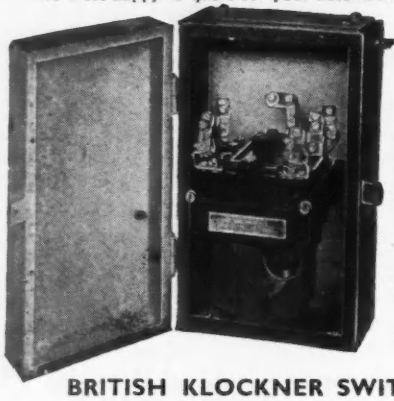
With the special off-peak tariffs now available through the electricity authorities the overall cost of thermal storage space heating has been reduced to a most economical figure. We are specialists in the design and manufacture of automatic panels for space heating control and have supplied panels handling up to 500 kW.

The panel illustrated handles 267 kW and is divided into 16 zones with individual limit thermostats and overall control by time-switch, together with anticipatory control unit. We shall be most happy to quote for your automatic control panel.



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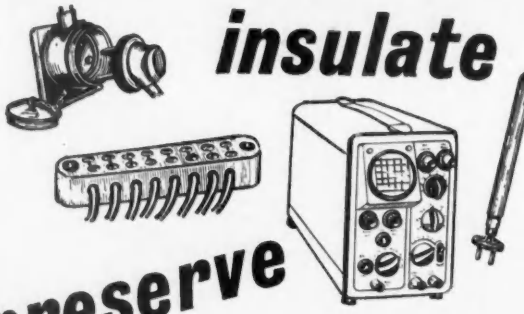

insulate

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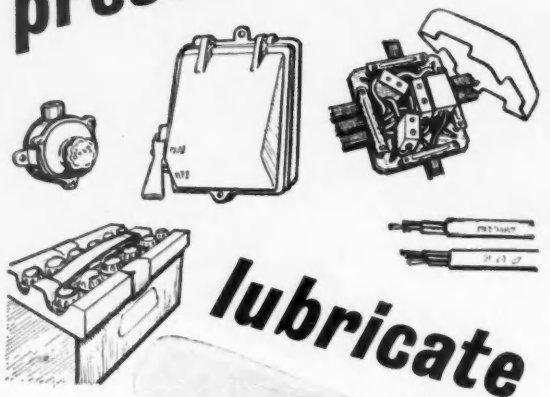

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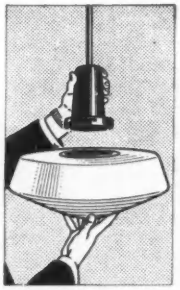
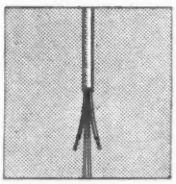


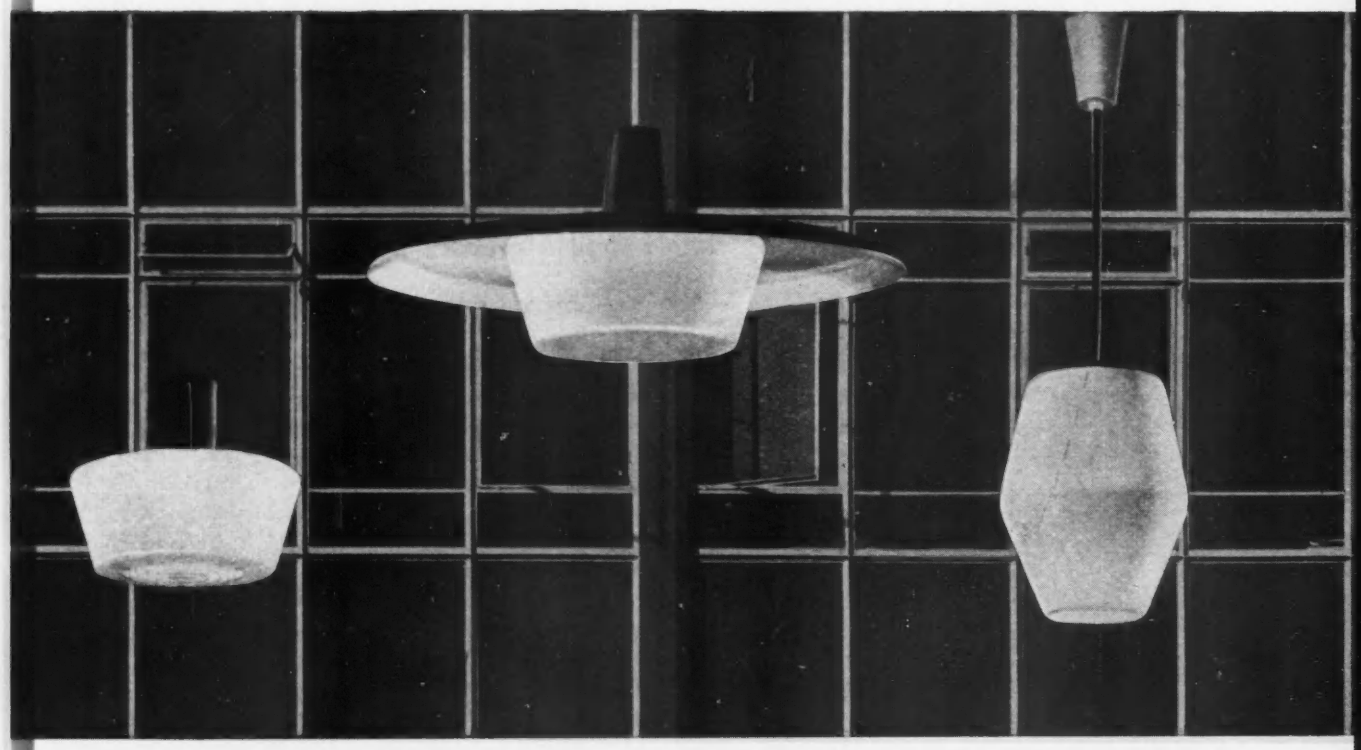
New simple 'TURN and LOWER' action for easiest ever installation and maintenance.

G.E.C's new positive bayonet fixing with 'turn and lower' action means EXECUTIVE glasses can be fixed or removed in an instant, saving time and money on maintenance and lamp replacement. (Patent applied for).



EXECUTIVE suspensions in ten different lengths are either ½ in. silver anodised aluminium tube or this new steel reinforced white flexible. (Patent applied for).

Internal locking screw on lampholder prevents unscrewing when relamping.



EXECUTIVE

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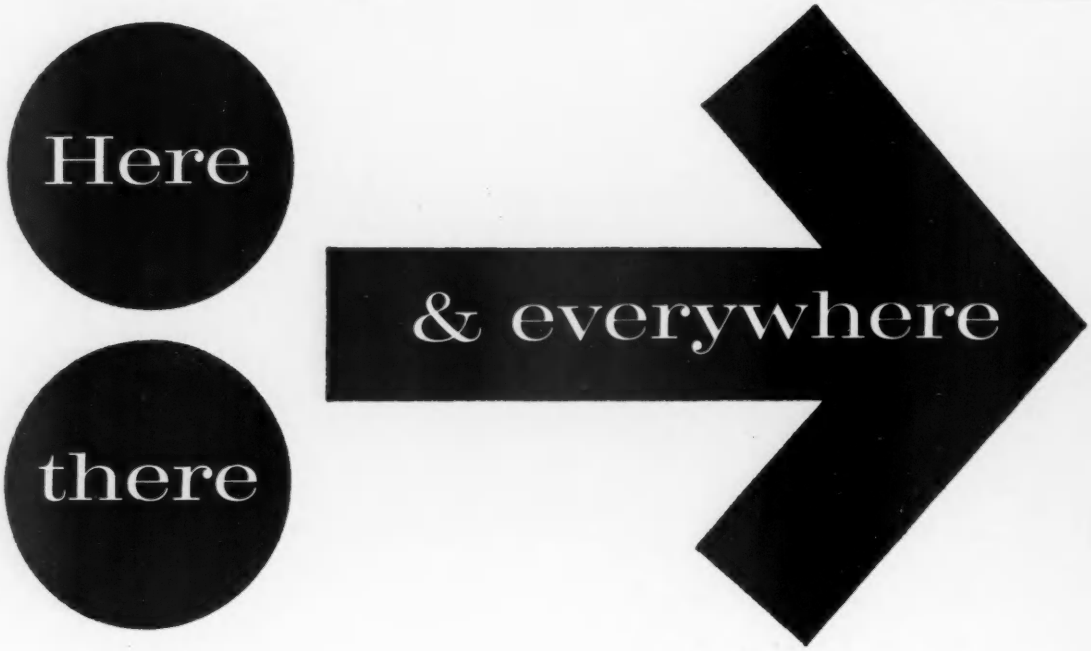
LIGHTING & HEATING GROUP, THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

Class H



Class H and Class C silicone-insulated dry type transformers are in the centre of things nowadays—in general use *at load centres*. And it doesn't matter if it's on the 1st or the 17th floor, in the factory roof or next to the warehouse. Class H and C dry-type transformers are *safe*—anywhere. Not affected by dust or humidity. Fire and explosion proof. And because they withstand repeated overloading, ratings need not be based on peak loads.

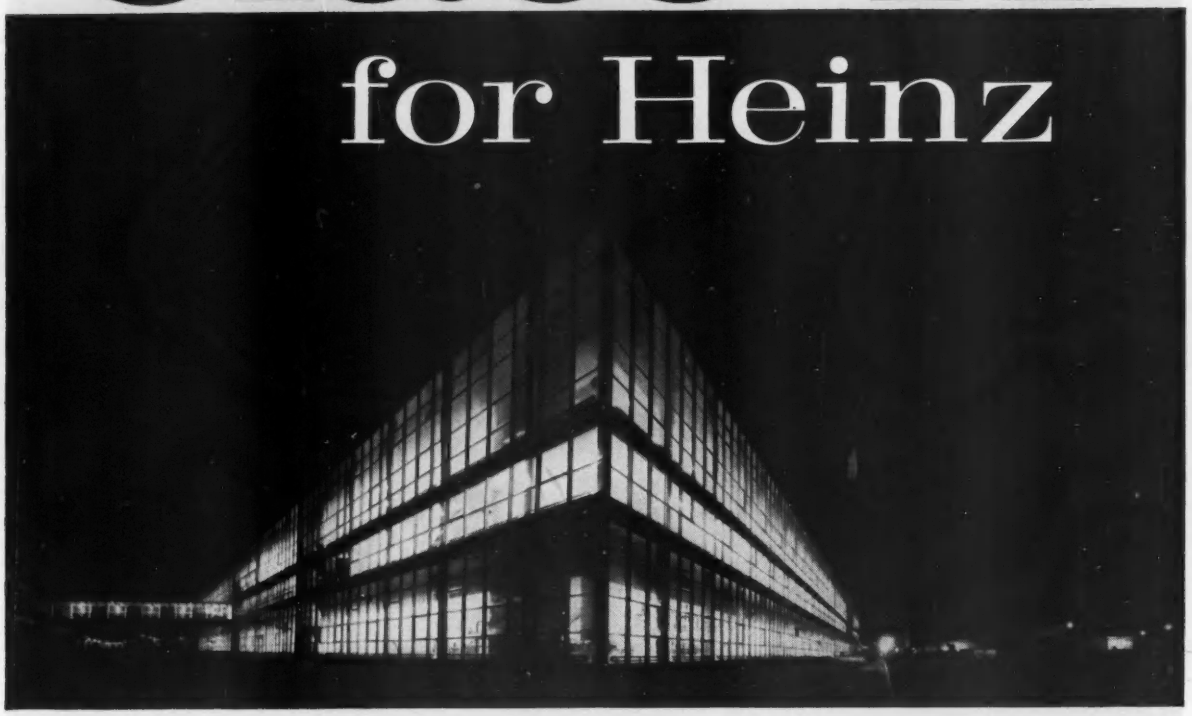
Among the leading firms and organisations using Class H and C transformers are *Shell, Unilever, The Steel Company of Wales, Vauxhall Motors, Ford Motors, Rolls-Royce, Pilkington Brothers, Central Electricity Generating Board, National Coal Board, Air Ministry, The BBC* and *British Railways.*

For safety, reliability and low maintenance costs, silicone-insulated transformers hold every advantage.

MIDLAND SILICONES supply the silicone resins and elastomers for Class H and C transformers. Such transformers are manufactured by the following companies :- *Associated Electrical Industries (Manchester) Ltd · Bonar, Long & Co Ltd · Brentford Transformers Ltd · Brush Electrical Engineering Co Ltd · Crompton Parkinson Ltd · Denis Ferranti Co Ltd · The English Electric Co Ltd · Ferranti Ltd · Foster Transformers Ltd · The General Electric Co Ltd · Gresham Transformers Ltd · Hackbridge & Hewittic Electric Co Ltd London Transformer Products Ltd · C A Parsons & Co Ltd · Bruce Peebles & Co Ltd · South Wales Switchgear Ltd · Transformers (Watford) Ltd · Woden Transformer Co Ltd · The Yorkshire Electric Transformer Co Ltd.*

MS

Class H for Heinz



Three thousand people at Kitt Green, the new Heinz factory near Wigan, share a brand new building with FOURTEEN Class H transformers.

Smaller and lighter than oil-filled units, these fourteen BRUSH transformers, rated at 500 kVA, three-phase, 50 cycles, 6,000/433 volts, have been installed in a number of sub-stations on the mezzanine floor between the two main production halls. The reason for choosing Class H dry-type transformers is briefly stated by Heinz themselves:

"*These transformers have been selected for reduced fire hazard, particularly with reference to the fact that most of them are installed within the main building. This gives an associated advantage of less complex design of Sub-Station and improved fire insurance arrangements.*"

There is no need for special enclosures, nor for special fire-fighting equipment, since Class H transformers are fire and explosion proof. Having transformers *anywhere* in the factory, at load centres, means low-voltage cable runs are very much shorter and floor excavations are rarely needed.

If you are not already a recipient of our regular news bulletin on the applications of silicones, 'MS News for Industry', please write for a copy.

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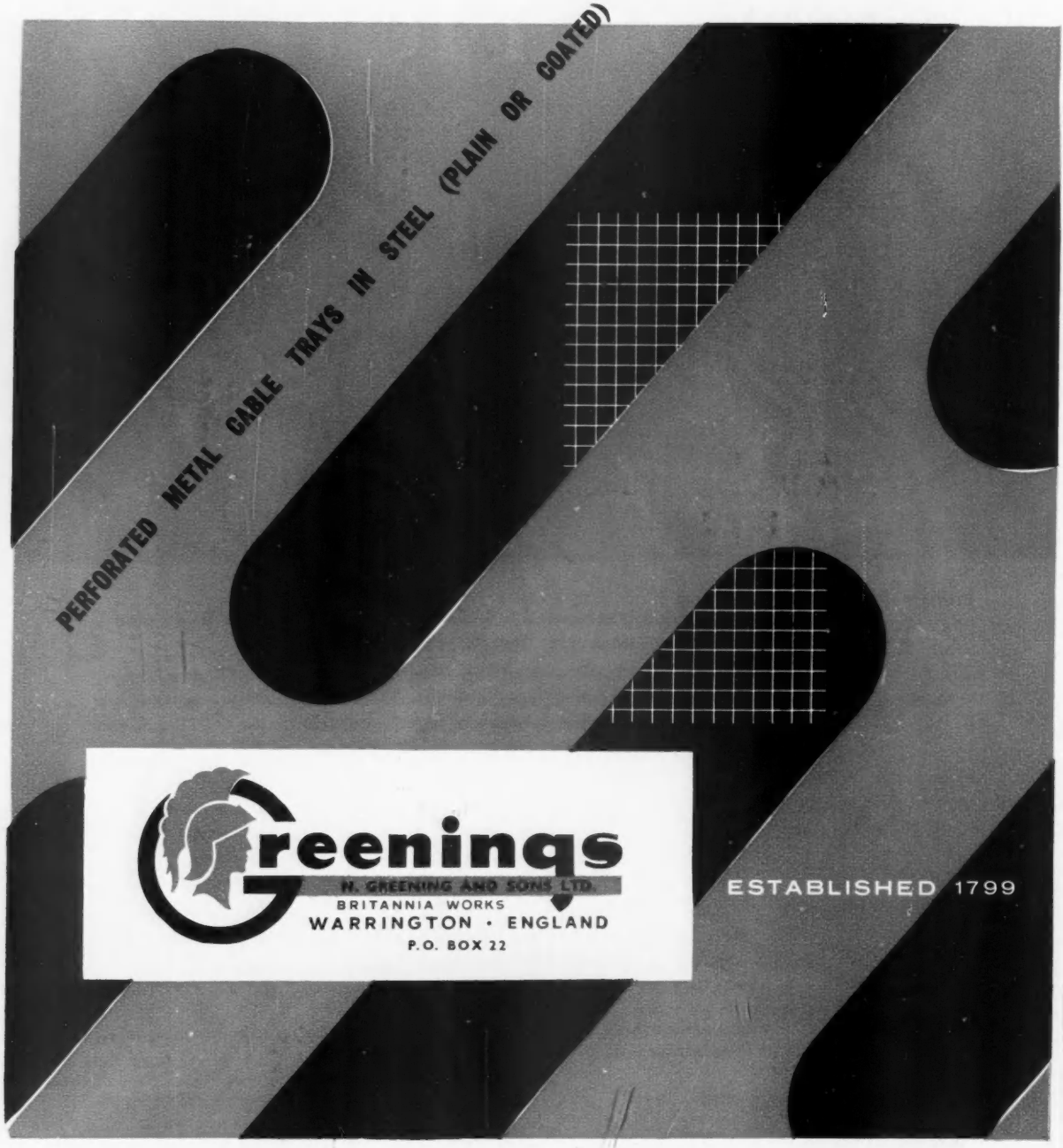
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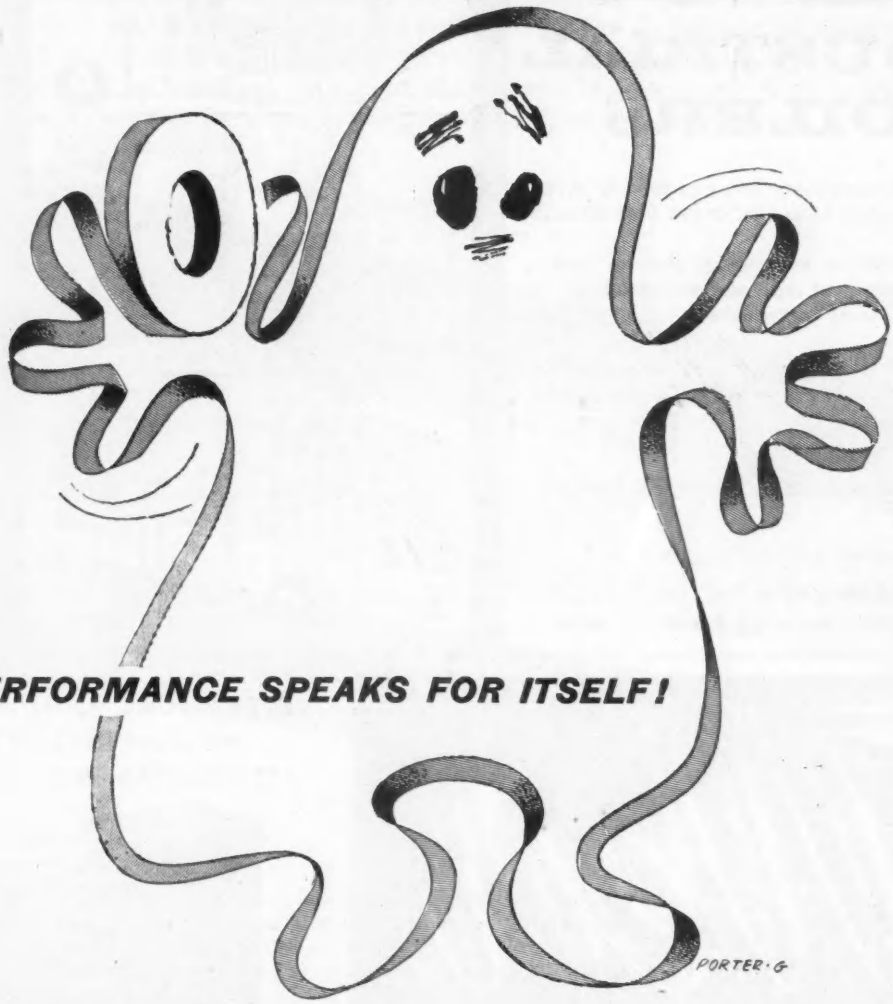

ITS PERFORMANCE SPEAKS FOR ITSELF!

Lasso No. 92 has so many properties, so many uses, we could fill this page with them. And dull reading it would make. A lot of stuff about pliability, water resistance, acid resistance, wrapping, jointing, insulating, binding, splicing — *that* sort of thing. Far better send for our alert young representative, *he* makes it sound interesting. Ask your secretary to drop us a line today.

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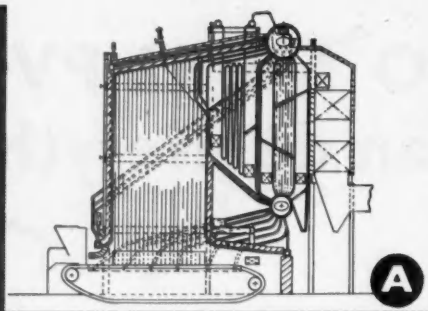
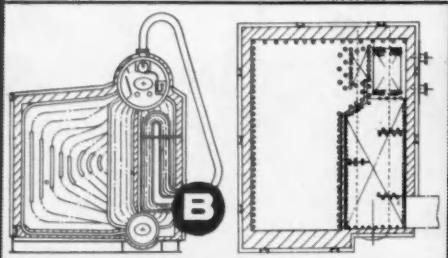


A
One of a comprehensive range of stoker fired boilers.



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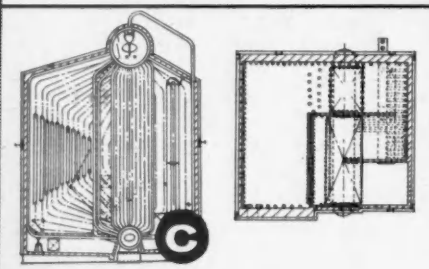

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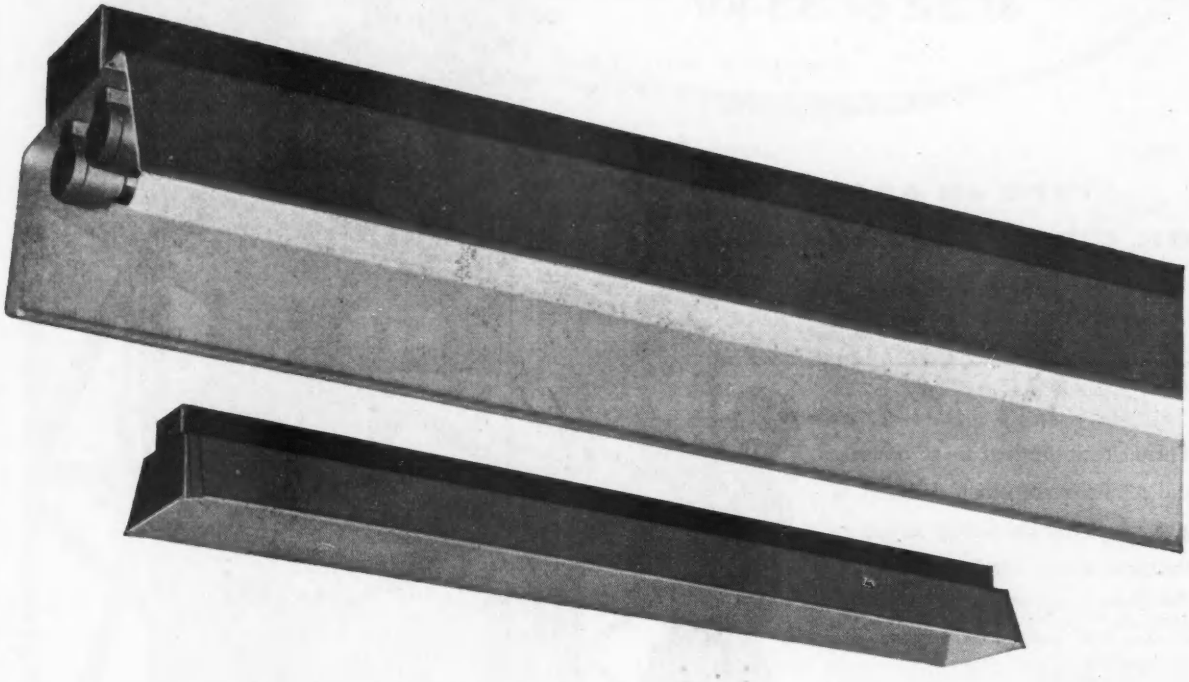

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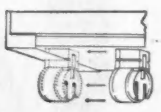

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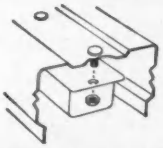

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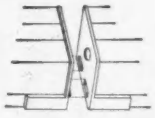

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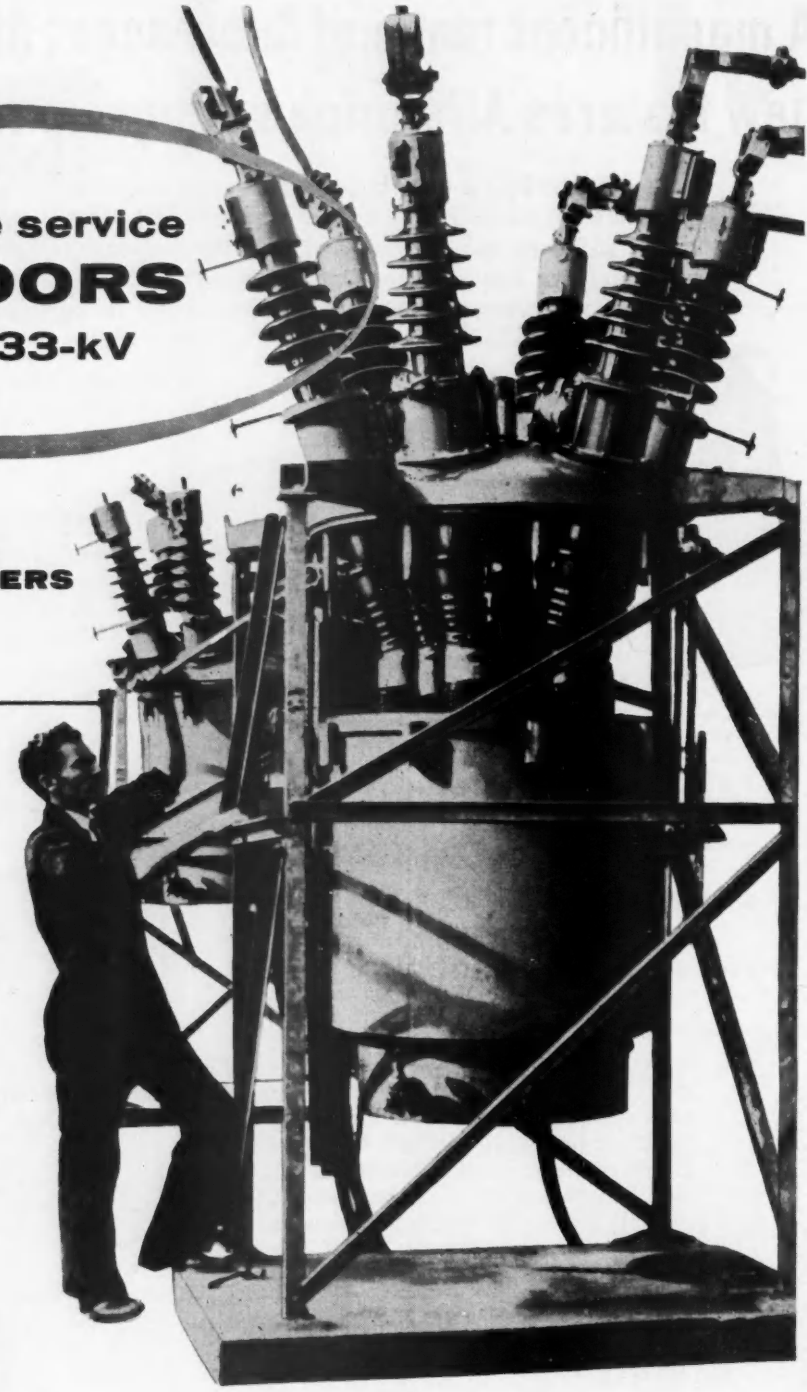

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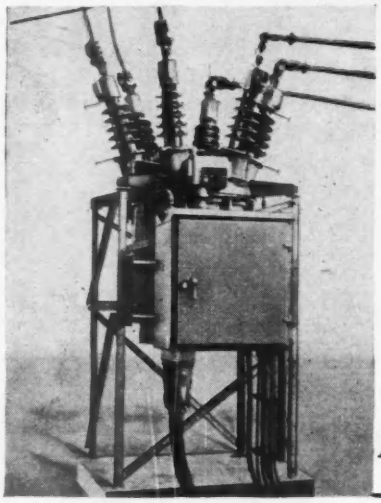

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THURSDAY 8 JUNE, 1961
Registered as a Newspaper Volume 139 No. 23

ELECTRICAL TIMES

SARDINIA HOUSE, SARDINIA STREET, LONDON, W.C.2
Telegrams: Equivolt . Estrand Telephone: HOLborn 6016

Dans ce numéro

Branchement de charge à l'extrémité des câbles sous tension extrêmement haute 901

Le contrôle de la direction de l'effort électrique à l'extrémité d'un câble sous tension extrêmement haute peut s'effectuer par les méthodes suivantes: répartition de résistance au moyen d'un tube de porcelaine ayant une couche semi-conductrice émaillée; configuration des électrodes; ou bien répartition de capacité. Les valeurs supérieures de tension obtenues avec ces trois méthodes sont approximativement les suivantes: 230 kV, 330 kV et 425 kV respectivement. Un branchement à base de " cônes condensateurs " préfabriqués à l'extrémité d'un câble de 275 kV a opéré de manière satisfaisante dans des conditions d'essai. L'étude des branchements d'extrémité pour ces câbles tend vers l'utilisation de matériel complètement préfabriqué en usine.

Conversion directe de l'énergie 909

Les cellules de silicone activées par la lumière solaire représentent une des méthodes de conversion directe d'énergie en électricité dans les cas—par exemple dans les véhicules spatiaux—où il est nécessaire d'obtenir des basses puissances avec une sûreté de fonctionnement élevée. Certains matériaux peuvent être utilisés pour convertir l'énergie mécanique directement en électricité, et ils ont de plus l'avantage de donner un courant alternatif. Les " cellules de fission " convertissent directement en électricité l'énergie cinétique des fragments chargés électriquement qui proviennent de la fission nucléaire.

Nouveau câblier pour câbles téléphoniques 919

Le H.M.T.S. " Alert " de 4.200 tonnes, qui vient d'augmenter la flotte des câbliers des Postes britanniques, est prêt à entrer en service dans l'Atlantique nord. Ce navire participera à la pose de la liaison téléphonique entre le Royaume-Uni et le Canada. Il est très maniable, et est équipé de deux hélices; la propulsion est diesel-électrique, et les services auxiliaires sont entièrement électriques. Pour que la manoeuvre de direction soit plus aisée, le navire est équipé d'une hélice transversale avant; il comporte aussi les plus récents appareils radio et radar.

In dieser Nummer

Endverschlüsse für Höchstspannungskabel 901

Eine Kontrolle über die Richtung, in der sich die elektrische Belastung am Abschluss eines Höchstspannungskabels auswirkt, kann durch folgende Massnahmen erzielt werden: Widerstandsabstufung unter Verwendung eines Porzellanrohres mit einer halbleitenden Glasurschicht; Elektrodenformgebung; Kapazitätsabstufung. Ungefähre Grenzspannungen, bei denen diese drei Methoden angewendet wurden, sind 230 kV, 330 kV bezw. 425 kV. Ein aus " Keilkondensator "-Bausteinen bestehender Endverschluss für ein 275 kV Kabel hat sich im Versuchsbetrieb als zufriedenstellend erwiesen. In der Konstruktion von Höchstspannungsendverschlüssen wird man sich in Zukunft wahrscheinlich auf komplette Vorfertigung im Werk einstellen.

Direkte Energieumwandlung 909

Zu den Methoden der direkten Umwandlung von Energie in elektrischen Strom, und zwar in den Fällen, wo geringe Kraftmengen bei hoher Zuverlässigkeit erforderlich sind wie z.B. in Raumflugkörpern, zählt die Verwendung von mit Sonnenlicht arbeitenden Siliziumzellen. Mit Hilfe gewisser Materialien kann mechanische Energie direkt in elektrischen Strom umgewandelt werden. Dies bietet den Vorteil einer Wechselstromerzeugung. " Spaltbatterien " wandeln die kinetische Energie elektrisch geladener Kernspaltungsfragmente direkt in elektrischen Strom um.

Ein neues Kabelverlegungsschiff für Fernsprechverbindungen 919

Die Flotte der britischen Postkabelverlegungsschiffe hat als neuesten Zuwachs die 4200 Tonnen H.M.T.S. " Alert " erworben, die nunmehr zum Einsatz im nordatlantischen Ozean bereit ist dieses Schiff soll bei der Verlegung des zwischen dem Vereinigten Königreich und Kanada vorgesehenen Kabels mithelfen. Die " Alert " besitzt grosse Manövrierfähigkeit, hat zwei dieselelektrisch angetriebene Propeller und durchwegs elektrifizierte Hilfsanlagen. Ihre Manövrierfähigkeit wird noch durch einen Bugpropeller erhöht, und sie besitzt die neuesten Funk- und Radareinrichtungen.

E.H.V. Cable Terminations 901
by S. C. Chu, B.SC.(ENG.), A.M.I.E.E.

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SUBSCRIPTION RATES: United Kingdom £4. Overseas £4 10s per annum. Canada and USA $12 per annum. Subscriptions are payable in advance and may commence with any issue. Overseas subscriptions may be paid by banker's draft, cheque, international money order or credited to the Electrical Times Ltd., at Coutts and Co., 440 Strand, London WC2. Single copies price 1s 6d. Postage 6d.

SOME INSIDE INFORMATION ON.....

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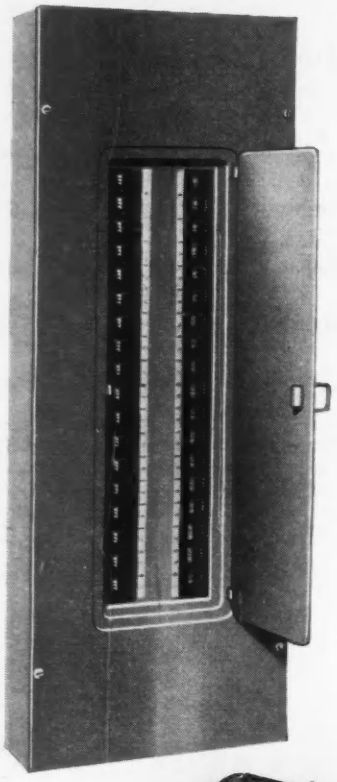

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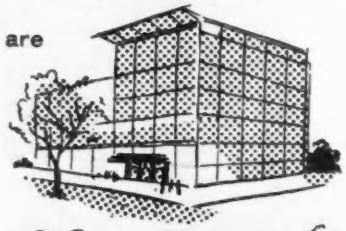

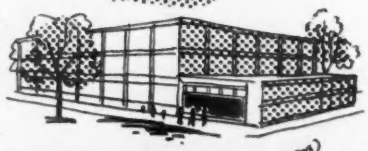

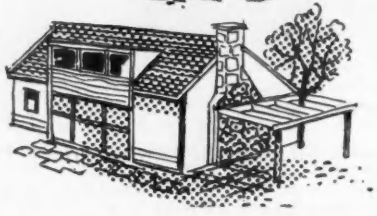

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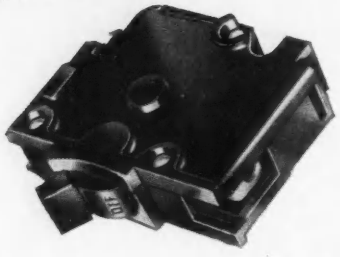

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ELECTRICAL TIMES

ESTABLISHED 1891

THURSDAY, 8 JUNE, 1961

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T. W. WRIGHT

Comment

CHANGES AT THE TOP

The news that the retirement of Sir Josiah Eccles from the Electricity Council is to be followed closely by that of the chairman, Sir Robertson King, will be received with some concern within the industry. It is not easy to visualise the full effect of the loss of these two men, so long respected as leaders of electricity supply, continuing a long tradition of public service. The new chairman of the Council is to be a relative newcomer to the industry, Mr R. S. Edwards, formerly professor at the London School of Economics, whose early contact with the supply industry came through his membership of the Clow Committee in 1948 and the Herbert Committee in 1954. Since his appointment as part-time deputy chairman of the Electricity Council in 1957, he has had an important voice in the affairs of the industry. Now he reaches the top of the supply tree at the early age of 51, with the expectation of many years of service ahead of him. His appointment by the Minister of Power is an imaginative one, and it opens up questions about the functions of the Electricity Council which have been simmering for some time. The Council has been active in its duties of financial adjustment between the autonomous operating units of electricity supply and in operation of the negotiating machinery for wages and salaries; but in other fields it has not had the impact that many felt it should. It has been overshadowed by the up-and-doing CEGB. Mr Edwards has shown himself, in published papers, quick to appreciate the special features of electricity supply finance. The chairmanship of the Electricity Council demands broader qualities. It is the position which should represent the industry in the public eye. This is the new and onerous responsibility that Mr Edwards has to face. His first task is to become more widely known within the industry. In this and his other duties he will have an able deputy of long supply industry experience through the promotion of Mr C. T. Melling.

TROUBLE WITH TENDERS

Amongst many topics of contention at the Electrical Contractors' Association diamond jubilee conference, one on which contractors showed particular concern was that of tendering practices and contract conditions. This is no new problem. The interest-filled review of 60 years of Association history which Mr L. C. Penwill prepared for the conference included a reference to early-1916 discussions on this same subject. But today's consideration of the question has to be seen against today's high costs and technical complexity. Unrestricted competitive tendering has been well demonstrated as adding severely to the overhead costs

Next week's "Electrical Times" will be a special issue on the occasion of the 13th British Electrical Power Convention

of the industry as a whole. Government-supported committees have condemned it. Yet the ECA finds little progress in the adoption of selective tendering, which could cut costs without severely restricting competition. Again, the conditions of tender and contract, to which contractors have to work, by their very variety impose much unproductive labour in analysis of their implications. If these aspects of getting an order can be brought more in line with modern ideas of efficiency and productive effort, then a real economy might be passed on to the industry's customers. Whether that would come directly is less certain. The argument that contractors need to work to bigger margins, so that they can afford more and better equipment, was also forcibly expressed at the conference. It is an approach that invites cynical comment, but it has a strong element of justification all the same. Electrical contractors are less well equipped in general than the nature of their work makes desirable. The smaller firms include amongst their numbers a substantial proportion who tender too closely, too often.

CABLE TERMINATION TRENDS

As transmission voltages climb higher, the problem of designing cable terminations becomes more demanding. It is largely an electrical question, the complications introduced by mechanical considerations being less pressing than in other details of cable installation design. Essentially, the need is to control electrostatic stress so that it retains as far as practicable the radial pattern it has in the cable as a whole. The principal methods of achieving this are the subject of the article that begins opposite. For the highest voltages, including the 400 kV that is imminent in Britain and the 700 kV that is the projected next step, some form of capacitance control seems the most acceptable. At the highest voltages, every detail of construction must be watched. This consideration argues for factory prefabrication wherever possible, as against the site preparation that constitutes one of the main skills of the cable jointer. Cable stress cones, in which capacitor electrodes are inserted and whose profiles are accurately shaped from full-length papers, add to the accuracy of stress control, reduce jointing time on site, and so cut down the risk of human error. Design progress in this and other aspects of terminations has to be watched with the knowledge that the number of cable terminations in the transmission system is likely to increase. This will follow from the suggested policy of undergrounding the last mile or so of cables into switching stations.

POWER FROM OCEAN BREAKERS

Tides as a source of power fascinated scientists long before the advent of electricity and, since that time, many have been the proposals for tidal generation of electricity. A new approach to obtaining power from the sea has been under consideration at Mauritius. The proposal is to harness the rollers of the Indian Ocean, which break as high as 4 ft to 12 ft on the coral reefs. A shallow lagoon drained at low tide is planned as the reservoir, constantly replenished by the breakers, which would be guided up a concrete ramp of special design, the shape of which is being determined by the Hydraulic Research Station. Perhaps the surprising thing about this proposal is that an output of 44 MW is estimated as the potential of the scheme, but for the first stage a capacity of 9,280 kW is the aim. One advantage of such a scheme is the absence of tides as a major factor; they are only slight in this area. Thus, the interrupted generation cycle which has always inhibited the development of simple tidal schemes is avoided, and more continuous generation should be possible. Technically, the proposal appears feasible, but its economic practicability must await an extended study of the height and frequency of the breakers in the area of the lagoon.

FACTS FOR EXPORT

Statistics are usually the basis for building up an overall picture. To the commercially minded, however, statistics only become of value when available in the smallest possible breakdown; figures for the particular sector in which one is interested. Then the trading performance of one's own firm can be judged against the total volume of a particular market for a particular piece of equipment. The Board of Trade monthly returns of exports provide little more than an assessment of an industry's overall export performance; detailed figures of the returns from which the totals have been compiled have only been available on special request. Now BEAMA has taken the useful step of publishing such detailed information for the last three years, and in a 46-page booklet the value of exports of any electrical classification to any country are given. This is a useful commercial service. Any firm, from its own figures, can now ascertain its performance compared with that of its British competitors. Unfortunately, it gives no clue to what foreign competitors are achieving in the same markets. Such information is more difficult to obtain, since it can come only from statistics of other countries. The delay is inevitably greater. Complete figures are not always available, nor do the classifications of equipment always correspond, although more countries are now adopting the standard Brussels classifications. If such comparisons could be made regularly available, if in only limited form, they would greatly add to the commercial value of export statistics.

Meteor

This week's quick summary of electrical news faces advertisement page 8

E.H.V. cable terminations

RECENT DEVELOPMENTS REVIEWED

by S. C. Chu, B.Sc.(Eng.), A.M.I.E.E.*

IN Great Britain supergrid transmission voltages have been increased from 132 kV to 275 kV. A recent announcement by the Central Electricity Generating Board states that the voltage will soon be further extended to 400 kV, thus bringing this country to the fore in the field of high voltage electrical power transmission. The need to consider a higher voltage is brought about by the continuing growth in the demand for electricity—which is rising faster than ever before. This trend toward higher transmission voltages is also universal abroad.

The substantial increases of transmission voltage have confronted engineers with many new and complex insulation and manufacturing problems in the design of h.v. plant such as transformers, switchgear and associated equipment, of which power cable is no exception. The details of some of the modern installations of e.h.v. power cables above 132 kV throughout the world, including manufacturing problems and test requirements, have been described in a recent paper.[1] The installations are briefly summarised in Table 1.

In e.h.v. cable systems, terminations and joints are always the two most important accessories in the installations. Unlike the cable itself, in which the electrical performance can usually be predicted with a fair degree of accuracy, the conditions of stressing in terminations and joints are complex. The insulation, moreover, frequently has to be applied manually and be finally impregnated on site, thus more variables are involved.

While a joint may be avoided in a short cable route, terminations are absolutely necessary in all installations. In the case of a joint, owing to its continuous external screening, the electric field is confined to the oil and paper. Therefore, the electrical design may not be so involved as are the mechanical considerations. This is not so in a termination, where the electric field will cause potential gradients in several different dielectrics—paper, oil, porcelain and air. In outdoor installations, the external field distribution is also influenced by the weather and ambient conditions, i.e., the effect of atmospheric pollution. The problem is further complicated by some peculiar phenomena associated with such fields at extra-high voltage gradients. Consequently, all designs have to be proved by full-scale tests.

The aim of the present paper is to try to give a brief and integrated review of the different types of electrical design of e.h.v. cable terminations in existing installations, with particular references to actual 275 kV terminations where prefabricated condenser cones are used as, for example, in the installations at Hinkley Point nuclear power station now under construction in this country. This type of termination is an entirely British achievement following the inception of the so-called condenser cones many years ago. The author was involved in their early designs and has continued investigations of their use in extra-high voltage systems up to 400 kV.

* Mr Chu is with Enfield-Standard Power Cables Ltd.

E*

Stress-control Techniques in Terminations

The main requirements of an e.h.v. cable termination which influence the electrical design are:

(1) Uniform voltage distribution inside the porcelain.

(2) Co-ordination of internal and external dielectric strength so that flashover, if it occurred, would be confined to the outside of the porcelain.

(3) Minimum diameter of cable assembly to keep the dimensions of the porcelain small in order to limit the hoop stress, etc., developed by internal pressure.

(4) Easy assembly and impregnation on site.

The first three requirements can be achieved by suitable control of the electrical stress. Stress control is achieved by ensuring that the insulation is so dimensioned as to withstand the electrical stresses which appear along and across the end, aiming, as far as possible, at uniform voltage distribution.

Table I. Some Recent E.H.V. Cable Installations

Approx. year installed	System Voltage kV	Type of Cable	Route or Installed Length	Country Installed
1953	275	O.F. Gas Compression Impregnated Pressure	400 yd (total)	Great Britain (Staythorpe)
1954	300	O.F.	2 circuits each 670 yd	Canada
1955	400	O.F.	133 yd	Sweden
1956	425	O.F.	33 yd	Sweden
1956	230	Pipe Type Compression	3 Circuits each 1,000 yd	USA
1957	300	O.F.	12 km	Norway
1957	230	O.F.	4 circuits total 42 miles	Canada
1959	330	O.F.	500 yd (route)	Australia
1959	330	O.F.	3 circuits each about 500 yd	Southern Rhodesia
1960	275	Pipe Type Compression*	6 circuits each about 780 yd	Great Britain (Hinkley Point)

* Further installation will be made in Scotland.

It is well known that when a cable is submitted to a potential between the conductor and sheath, the potential gradient is non-uniform along the exposed surface of the cable dielectric, the steepest gradient, or maximum stress concentration, occurring in the vicinity of the cable sheath. In high voltage systems, it is common practice to reinforce the cable end to control the stress by applying a pre-impregnated paper roll of insulation, adjacent to the end of the sheath. The paper roll is formed to a predetermined cone shape and checked by a template. For system voltages below 66 kV, a paper roll smoothly tapered to a straight-line contour is adequate, but for system voltages of 66 kV and above, the profile contour of the paper roll is calculated from a well-established logarithmic formula[13] assuming empirical data for the radial and longitudinal stresses, the nominal value of the latter being usually limited to 2·5 kV/cm. In all cases a metal screen, usually consisting of lead wires, is applied from the cable sheath up over the stress profile. It is suitably secured by soldering. A straight portion of paper roll is left beyond the end of the lead wire.

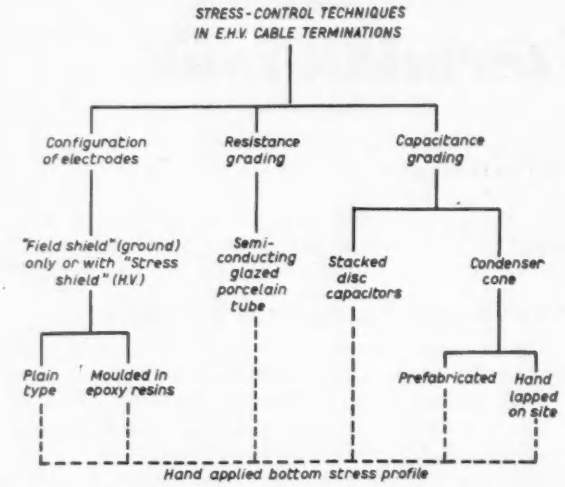


Fig. 1. Stress control techniques used in e.h.v. cable terminations

Terms commonly used: *Termination*, otherwise known as terminal, sealing end, or pothead. *Field shield*, otherwise known as stress ring or lip flare. *Stress profile*, otherwise known as stress relief cone, stress control cone, profile, or paper buffer

At the top of the stress profile, where the metal screen is terminated, there is still a sharp increase of stress in the vicinity of the top turn of the lead wire. This stress concentration has been confirmed by experiments using an electrolytic tank. For system voltages above 132 kV, therefore, the stress at this region must be further controlled in order to ensure that no internal flashover occurs during the impulse and a.c. voltage tests. It should be borne in mind that the dielectric strength of lapped paper when the electric field is directed along or parallel to the lamination is very low compared to the strength obtained when the field is normal to or through the laminations. Longitudinal strength is only about one-fifteenth or one-thirtieth of its normal transverse strength.

The problems associated with such stress concentration phenomena in cable terminations for voltages above 132 kV can be solved in three different ways as shown in Fig. 1, which have all been used on e.h.v. outdoor terminations. Configuration of electrodes and capacitance grading have also been applied on oil-immersed sealing ends used for connecting cables direct into transformers or switchgear and which are consequently much shorter in length. The methods are:

(1) Resistance grading,
(2) Configuration of electrodes, and
(3) Capacitance grading.

Strictly speaking, (1) and (2) are actually further methods of capacitance grading, but the calculation of the capacitances in these instances to determine the electric field or voltage gradient is extremely difficult if not impossible. Since reliance is made on the impulse type test to determine the performance of a termination, the voltage distribution follows the electrostatic field set up by transient voltages.

Resistance Grading

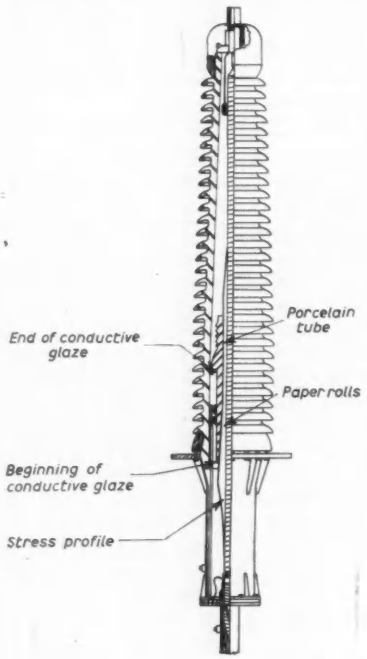
In resistance grading, a porcelain stress-control tube assembly is used which is positioned at the top of the stress profile[2] (Fig. 2). The tube has a semiconducting layer on the lower external surface and has a reasonably good fit over the top of the stress profile. The top petticoat is deep and has a smooth, curved surface further to improve the configuration of the electrode. This design ensures that the maximum longitudinal voltage gradient occurs in the homogeneous dielectric material of the porcelain rather than in the paper.

The curved conducting surface of the tube is installed well above the external metal parts, which also effectively increase the external flashover strength in air.

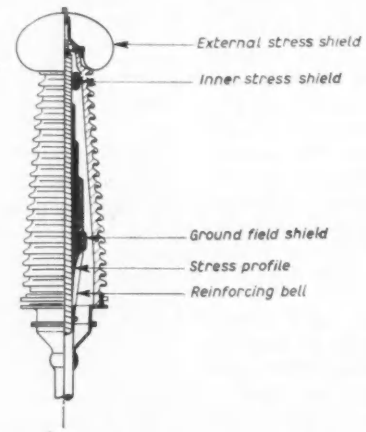
Local voltage control by resistance grading can produce local heating brought about by leakage current during service. Therefore, care must be taken to permit adequate dissipation of heat, especially at high ambient temperature or in strong sunlight.

Configuration of Electrodes

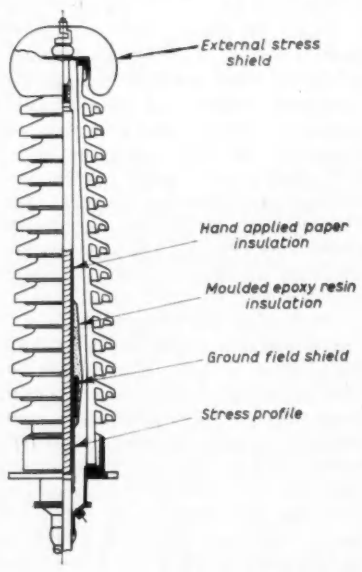
This design employs suitably shaped h.v. and l.v. electrodes to guide the electric field in the termination. The electrode is usually applied at the l.v. end known as



◀ *Fig. 2, left. Cable termination using resistance grading, involving porcelain stress control tube at top of stress profile*



▲ *Fig. 3, above. Cable termination with stress and field shields (plain type)*



▲ *Fig. 4. Cable termination with stress and field shields (epoxy moulded type)*

"ground field shield." Sometimes a similar "stress shield" is also applied at the h.v. end. The positioning of the "field shield" inside the porcelain will influence the external potential field in air.

In early designs, a plain type of metal shields were used[3] (Fig. 3) and required a large build-up of paper roll. The time required to build up a paper roll on the cable to a large diameter was therefore considerable, and a large diameter of porcelain was necessary to accommodate it and to obtain good voltage distribution. Its use has therefore been mainly on low-pressure, oil-filled cables.

For high oil pressures, an insulating tube was slipped on the cable core with built-up paper roll and stress profile, for pressure-retaining purposes. The shields were then applied over the paper rolls on the tube.

Field shields moulded in epoxy resin have now been developed[4,14] (Fig. 4), which enable the assembly to be prefabricated in the factory for slipping on to the cable end on site. The shield is in the form of a very elongated annular electrode of small diameter embedded in the epoxy resin, which is usually loaded with quartz powder. Since air bubbles are eliminated during casting, the high electric strength obtained ensures that the high longitudinal stress can be taken up by the moulded resin instead of by paper. This new type also permits the use of paper rolls and porcelains of small diameter, thus reducing overall costs.

When this construction is applied to oil-immersed termination, a h.v. stress shield, also embedded in epoxy resin, is usually included, together with a h.v. stress shield outside the porcelain.

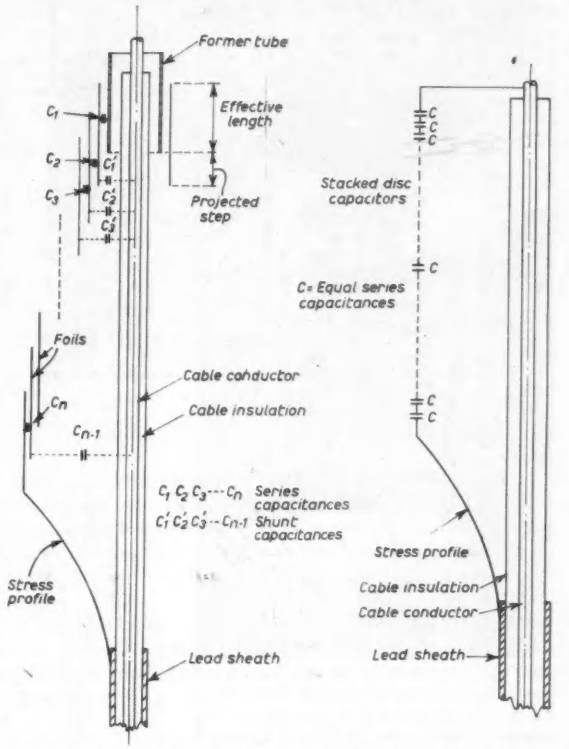
The calculations required to establish equal voltage gradients in these terminations are complicated and lengthy, although they can now be speeded up by the use of a digital computer.[5] In a typical study, the computing processes were carried out in two stages, using coarse and fine meshes. The total computing time was approximately eight hours, including the time taken for the input of the data and the output of results.

Capacitance Grading

Capacitance grading is perhaps the principal method for stress control in cable terminations. This method is used in the design of condenser cones which were developed some 30 years ago.[6] Since their inception, condenser cones have been used satisfactorily both for cable testing and in field installations for many years.† With the growth of extra-high voltage transmission, modified designs utilising the same original principle have made further advances possible.[7,8,9]

Referring to Fig. 5, which shows diagrammatically the physical arrangement of the foil electrodes, the various capacitances involved in a condenser cone type cable termination, neglecting the capacitance of foils to earth, can be divided into series and shunt capacitances. For uniform voltage distribution the capacitances between any two successive foils are so graded that equal voltage differences result. This means that the series capacitances between the effective length of foils must be increased in the correct proportion with the longitudinal distance from the high voltage end of the cone (i.e., the small or top end), and the shunt capacitances between the projected steps of the foils and the conductor must be decreased inversely. Accordingly, near the low voltage end the series capacitance must be large and the shunt capacitance very small. Fortunately, this requirement can be met without much difficulty in the inverted type of condenser cones illustrated,

† Condenser cones of special design have also been used in protective systems, etc.



Figs. 5 and 6. Left, Fig. 5. Diagram of condenser cone type cable termination. Right, Fig. 6. Diagram of disc capacitor type cable termination

because the increasing diameters of the foils from the h.v. end to the l.v. end increases the foil area, while at the same time the shunt capacitances are decreased owing to larger radial distances.

It is obvious, therefore, that uniform voltage distribution can be effected in three alternative ways.[10,11]

(a) By varying the insulation thickness between two successive foils while maintaining the projected steps equal.

(b) By adjusting the length of projected steps while keeping the insulation thickness between two successive foils constant.

(c) By arranging for equal projected steps and equal insulation thickness between two successive foils.

Design (c) is the simplest, although it may introduce somewhat higher stresses at the two ends compared with those at the intermediate steps. For a given cable size, however, by suitable choice of the foil dimensions, the potential distribution can be made sufficiently uniform for all practical purposes.

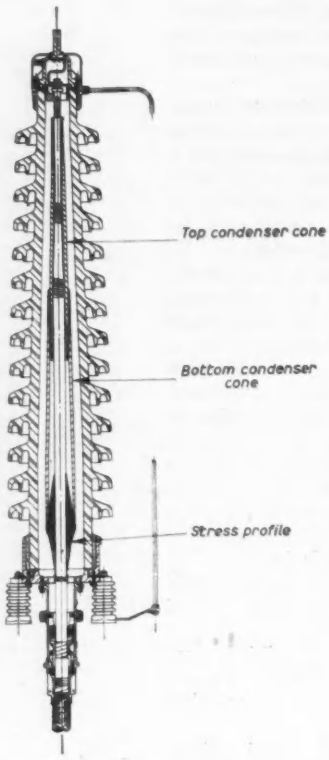
As all the capacitances can be calculated and verified by measurements based on the various known permittivities and the physical dimensions of the dielectric at the foil positions, the internal voltage distribution along the cable can be assessed with reasonable accuracy and calculations can be completed in about two hours.

All three types of design can either be prefabricated or formed by hand on site.

In the prefabricated type, the cone is fitted as tightly as possible over the top straight portion of the stress profile with the outermost foil connected to the lead wire on the profile. The advantage of using prefabricated condenser cones is that it is possible to manufacture, inspect and test them in the factory under controlled conditions. A cable termination can, moreover, be completed in a very short

▲ *Fig. 7, above. Experimental cable termination with external stress and field shields*

Fig. 8, right. Prefabricated condenser cone type cable termination for 275 kV system (Hinkley Point) ▶



time, which is always advantageous under conditions of site erection.

The use of condenser cones has another important advantage in so far as the diameter of the stress profile can be kept low, thus enabling porcelain of small diameter to be used.

In another design, disc capacitors are stacked on top of each other, producing a long, smooth longitudinal stress grading over the cable core[12] (Fig. 6). The electrical design is very simple since shunt capacitances between the capacitors and the conductor are negligible. All the series capacitance steps can be made equal, and as long as this is achieved the actual value of the capacitance chosen is not critical. The lowest capacitor electrode is connected to the lead wire of the stress profile and the top to the conductor. Intermediate electrode can also be connected to equipotential screens of the cable and/or to the outside metal fitting of the porcelains if more than one is used.

The series capacitors are stacked around a central tube assembled and impregnated in the factory and immersed in oil for shipment to installation site. They can also be housed in a separate s.r.b.p. tube which is used to take the high oil pressure continuously on the cable. This form of construction requires a porcelain of large diameter.

External Stress Control

In general, a carefully internally graded and suitably positioned cable assembly with respect to the metal fittings of the porcelain should satisfactorily meet the test and service requirements under normal atmospheric conditions. To increase the external flashover, however, an external stress shield with or without field shield can also be used in conjunction with any of the three types of internal stress control,[3,9] (Fig. 7), in order to give a smooth configuration of electrodes. The effect of using an external stress shield (h.v.) is more pronounced than an external field shield (ground). The diameter o the shield also influences the flashove voltage and the shape of the shield ca be designed with a sinusoidal contou

Under polluted conditions, th length of leakage path of the porcelai is the main factor in determining th electrical performance of an outdoo cable termination. As a rough guid this length in inches should be equa to the system r.m.s. voltage. The con figuration of the leakage path must b carefully designed so that the ratio o the length of the leakage path to th overall length of the porcelain is abou two. The use of a porcelain with it external surface completely glaze with semiconducting material b resistance grading technique can giv satisfactory service if some care i taken to give the desired surfac resistivity (about 10 megohms), and t maintain good contact with the meta fittings of the porcelain. For a glaze porcelain, a leakage path of abou three-quarters of the system r.m.s voltage is considered adequate.

Prefabricated Condenser Con Termination for 275 kV Systen

As shown in Fig. 8, two prefabricate condenser cones, each 50¼ in. long were used for a 275 kV termination[1] and they were telescoped to form an electrically continuou unit. The overall length of the condenser cone assembl was 85¾ in. with an effective graded length of 71 in.

The use of two condenser cones in series simplifie manufacture, processing, shipment and installation. Eac cone was made with a continuous paper roll of full width so that unlike the hand lapped type there were no gap in the insulation due to the helical winding of the pape tapes.

Each cone has 25 foils. The reason for this large numbe of foils (50 in all) is to take advantage of the highe inception stress obtainable for the thin insulation betwee two successive foil steps. Thus a higher inception voltag can be obtained when compared with a design with th same total insulation thickness but with less foils.

The radial stress of the cone is such that it will co ordinate with the dielectric strength of the cable itself, i.e. the cable maximum stress. Owing to the length of porcelai used for 275 kV system, the longitudinal design stress i well within 2 kV/cm.

The development of the termination involved thre independent investigations.

(1) Verification of calculated voltage distribution.

(2) Obtaining the optimum position of the condense cone assembly inside the porcelain.

(3) Impulse and a.c. voltage tests.

While (1) and (2) were carried out on a small design experiment (3) was applied on a full-scale termination.

For experiment (1), voltage distribution was measured on a 33 in. condenser cone assembled on a solid type cable under oil with the top ¼ in. of each foil exposed for connections. A suitable voltage at 1 kc/s was applied and the voltages between the earth and each successive foil were measured with a high impedance valve voltmeter. The results are shown in Fig. 9. The small discrepancy between the calculated and measured values is attributed

largely to the capacitance between foils and earth which were neglected in the calculations. Since both distributions are substantially uniform, this discrepancy is of little practical importance.

For experiment (2), a 33 in. condenser cone was installed on an oil-filled cable inside a 66 kV porcelain in a normal way. The porcelain was adjustable up and down so that its metal fittings relative to the condenser cone assembly inside could be varied as required. Impulse voltages were applied in each position until flashover occurred. It was found that the positive and negative impulse flashover values were nearest to each other when the condenser cone assembly was so positioned that the distance between first and last foil was approximately midway between the metal fitting of the porcelain.

Full scale impulse and a.c. voltage tests were finally applied on a number of cable assemblies involving both oil-filled and gas compression cables. All withstood the 1050 kVp impulse test level required for 275 kV systems. The highest value and stresses are given in Table 2. There was no breakdown or any significant deterioration in the condenser cone assembly when examined after each test.

The a.c. test results are also given in Table 2. Since 1954, an experimental length of gas compression cable, including outdoor terminations of this design and a joint were tested by the CEGB at Staythorpe.

Table 2. Impulse and a.c. Test Results on Prefabricated Condenser Cone Cable Termination Designed for 275 kV System.

(The values quoted are highest among many results without any failure in condenser cones.)

Test	*Max. stresses, kV/cm.* *Impulse, 1,550 kVp*	*a.c. 450 kV r.m.s. 6 hr**
In Condenser Cones:		
Radial	500	145
Longitudinal ...	12·8	3·7
At the 10 in. stress profile:		
Radial at lip ...	146	43
Longitudinal ...	28·0	8·1

* 600 kV was applied for 30 sec; 350 kV was applied for 24 hr.

All the results proved satisfactory from the design point of view and a similar design of termination for 400 kV system is now available.

Summary

Internal stress control, which is essential in e.h.v. cable terminations, can be effected in three different ways, each of which is briefly described in the article. The assessment of the relative costs of these methods is of little significance since the cost involved is only a very small fraction of the total cost of an installed termination. Ease of construction and reliability are the governing factors.

Resistance grading may have limitations resulting from the heat developed locally so that the extent to which this type of termination can be used for voltage beyond 230 kV is problematical. Stress grading by configuration of electrodes has been applied successfully to systems up to 330 kV, but suffers from the necessity of lengthy calculations to establish the parameters of any make up. The highest system voltage at which the capacitance grading of one form or another has been used is 425 kV and it is reasonable to forecast that the application of this type of stress grading will prevail as the transmission voltages are increased.

The development of a termination using one form of capacitance grading with two prefabricated condenser cones in series for 275 kV as described, has been very satisfactory.

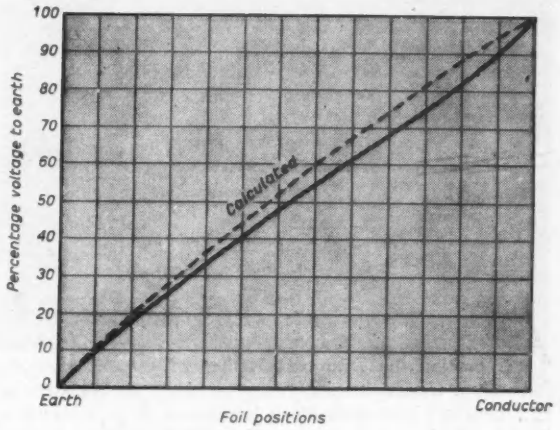


Fig. 9. Voltage distribution in a condenser cone termination

Under normal atmospheric conditions, internal stress control in a suitable porcelain would be adequate but, if necessary, external shields can be added to smooth any external stress concentration. For polluted conditions, suitable external resistance grading has been found satisfactory.

It cannot be over emphasised that, in addition to a sound electrical design, a carefully controlled technique must be established to ensure that complete evacuation and impregnation of an e.h.v. cable termination is assured on site.

Future Trend

It would seem that the future trend in the design of e.h.v. cable terminations, including the bottom stress profile, will be towards complete prefabrication in the factory. This will go a long way to reduce the effects of adverse climatic conditions in all parts of the world and to eliminate failures arising from the human element. The condenser cone form of construction described is a significant step in this direction, since it can be prefabricated together with the stress profile as an integrated unit.

Acknowledgment

Acknowledgment is due to Enfield-Standard Power Cables Ltd. for permission to publish this paper.

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E.C.A. in conference

DIAMOND JUBILEE CELEBRATED WITH ACCENT ON FUTURE

AT Torquay over the week-end, members of the Electrical Contractors' Association have been celebrating the Diamond Jubilee of the Association's formation. Under the presidency of Mr C. R. Waterhouse, J.P., members have been taken backwards in papers reviewing contracting and retailing since 1901, and forward to the problems of tomorrow in contracting (a paper) and in trading (a manufacturers' symposium), while a paper by Mr W. J. Jones, of the British Lighting Council, has brought them up to date about the design of office lighting.

Presidential Address

In his presidential address, which opened the conference after a civic welcome, Mr Waterhouse placed emphasis on the need for strengthening the various component parts of the electrical industry. Although he admitted to a personal preference for a voluntary basis of association, he expressed his doubts whether this system was correct in present-day circumstances. The ECA included the vast majority of private electrical installation contractors amongst its members, but there were many contractors who took the benefits of the Association's work without accepting any of its responsibilities, financial or otherwise. Even within the membership, there was a lack of acceptance of the moral obligation to take an active part in ECA proceedings. Mr Waterhouse said he was certain that the solution of many of the problems facing industry generally could be achieved only if every trader supported to the utmost his appropriate trade organisation.

The closure of the Electrical Fair Trading Council as a result of the Restrictive Trade Practices Act seemed to Mr Waterhouse "the negation of common sense, and a refusal to recognise the eminent desirability in the public interest of a suitable home trade." He was disappointed at the lack of support for efforts to form an *ad hoc* organisation to succeed EFTC as a forum for exchan of views within the industry. He appealed for reconsider tion of this subject and expressed the hope that somethi concrete along this direction might materialise before lor

Relationships with the area boards attracted spec comment from the president, who said that they increas in amicability as the years passed. However, he was l happy with the overall question of tenders and contrac He complained that the 1954 Howard Robertson co mittee's guidance on the subject of competitive tenderi had been largely ignored, not only by local authoriti and quasi-government agencies, but by some Governme departments as well. Although he did not object to t fundamental principle of competitive tendering, he believ that in the national interest a determined effort shou be made to reduce the wastage its present operati involved.

Resale price maintenance was defended by Mr Wat house as essential in the interest of orderly distributio He argued that the whole of the electrical retail communi which had any sense of responsibility to the public respect of the after-sales servicing of appliances, w unanimous in its view that the margin of trade discou allowed by manufacturers permitted no deduction wha soever by way of discount to the eventual purchaser. N retailer could sell electrical appliances at less than man facturers' list price and also give adequate technic service at the time of sale and thereafter. H urged the manufacturing community to restrict their di tribution outlets to people who were qualified by technic ability and practical experience to give adequate service.

Mr Waterhouse thought the NICEIC had tended to rai the standard of installation work in a number of direction However, the industry had found no solution to the tw problems of the thousands of people undertaking electric installation work who refused to submit themselves fo NIC enrolment, and the furth activities of the "do-it-yourself" br gade. He was horrified at the potenti danger to which a large proportio of the public was exposed in thes two directions.

During the past year, the Associa tion of Heating, Ventilating an Domestic Engineering Employers, th British Constructional Steelwor Association and the ECA had forme a joint committee to negotiate wit the professional side of the buildin industry and the National Federatio of Building Trade Employers. Th purpose was improvement of existin contract practices. The electrical con tractor has to expend too much effo at present in studying the condition under which he was called upon t quote.

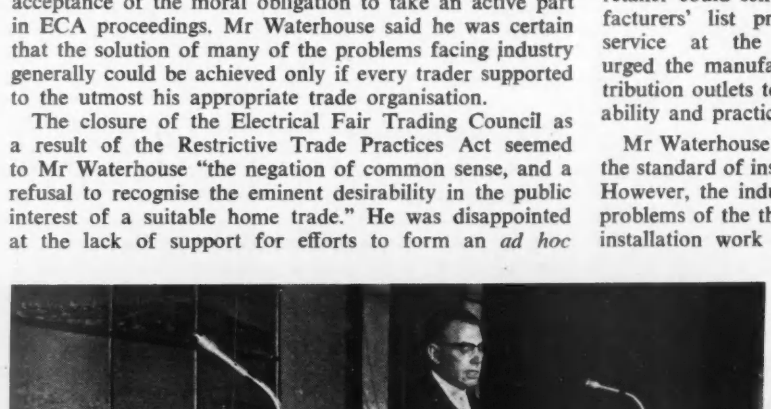

Fig. 1. At the opening of the conference, ECA president, C. R. Waterhouse introduces the Mayor of Torquay. Also seen (left to right), are Messrs C. J. Veness, G. N. Walker, and, the other side of the president, L. C. Penwill, J. G. Briggs and V. J. Stock

Contracting Future

Four senior members of the Association have co-operated to present a symposium of papers on its history. Mr L. C. Penwill traces the history, Mr A. V. Milton deals with the present and Mr S. L. M. Barlow deals with the future; and in the presentation, Mr J. G. Briggs acted as co-ordinator. Many are the intriguing sidelights on the development of the industry contained in Mr Penwill's paper, and Mr Milton's survey of present conditions contains some valuable reminders of what good contracting involves; but it is the paper on the future that demands space here.

Mr Barlow starts from some basic statistics, those resulting from Board of Trade Census of Production for 1954 (published) and 1958 (unpublished, but made available to him in part by the BoT). Comparing these two years, he finds that the number of contracting firms employing 25 or more workpeople had decreased substantially, but that the total value of work carried out by the firms was much the same. There was a decrease in the number of administrative and technical employees, and the total number of operatives employed on contracts decreased by more than 3%, but the cost of labour increased both in terms of money and in percentage of value of work done. Net output per person employed was considerably higher for these larger firms than those employing less than 25 workpeople. Mr Barlow considers that such trends are still effective.

Contractors are now aware that the industry works on far too small margins to allow for sensible development. There should be enough money to provide for improved tooling and first-class training for recruits.

The demands of training for specialised tasks suggest to Mr Barlow that there will be a far greater division between different aspects of contracting and between contracting and retailing in the future. On the contracting side, a feature will be employment of many more engineers, with firms using more finance and more specialised plant. At present, it is almost impossible to finance expansion out of profits, so there will be a trend towards larger and more efficient contracting units. He expects the contracting operations of area boards to decrease progressively, again in the interests of specialisation.

In retailing, rapid expansion seems likely, with imported equipment exercising a major influence. Here, competition from area boards through their showrooms will remain strong. The private electrical retailer will therefore tend to concentrate on efficiency and service in his existing field.

A broader view of education and training problems is required, with the employment of more apprentices and their encouragement to take their academic studies further. Mr Barlow would like to see a reasonable intake of university graduates as trainees. All in all, he estimates that the contracting industry will need at least a 25% increase in personnel over the next ten years. Against this background, he thinks the present labour content of about 50% in contracting activities makes it doubtful if sufficient study has been given to the possibility of increased mechanisation.

In the technical field, he has a number of suggestions to advance. Steel conduit, he thinks, should be used with an indented jointing arrangement, rather than the threaded connections. Although conduit joined in this way cannot readily be disconnected, it seems to him not a material shortcoming. Plastics conduit he finds daily gaining in acceptance on the Continent, and likely to increase in use here for house wiring and the simple types of installation. In the control equipment field, he suggests that vertical

Fig. 2. Messrs S. L. M. Barlow, A. V. Milton and C. R. Waterhouse at the "Past, Present and Future" session

rather than horizontal mounting of fuses for circuit protection should be considered from the points of view of ease of assembly and space saving. There may be some problem about heat at the top of the fuse bank, but sealed miniature circuit-breakers with temperature-compensating devices could make this unimportant.

Mr Barlow adds to these suggestions a list of possibly more tentative suggestions, including a greater trend towards standardisation, greater density of socket-outlets, and the supply of electricity on a rating basis rather than through a meter. He thinks, as well, there will be greater use of cables employing the outer protective sheathing as the neutral conductor. He also thinks that as contractors form themselves into their groups they will, in many cases, set up their own manufacturing units, absorbing the output in their contracting activities.

Contact with electrical contractors overseas is being maintained by the ECA, through membership of the eight-nation International Electrical Contractors' Association. This seems important for the future, both for information on overseas methods and because of the increasing amount of business that British contractors are undertaking outside the UK. Information comes on both technical and financial matters. For example, payment by results for wiremen has been tried in Denmark, Norway and Sweden, but the results have not been satisfactory. Mr Barlow is doubtful if such a system will be introduced in the UK.

In the commercial field at home, the future may lie in larger contracting firms, buying more of their requirements directly from manufacturers. The trading structure may be based on price leadership with a two-stage discount structure, one stage for the firm buying and selling, with a second stage for those also engaged in installation work. Mr Barlow sees a place retained for the wholesaler who stocks and distributes.

So far as contractors are concerned, he sees more negotiated contracts as a feature of the future, and suggests that the ECA will employ legal assistance to further improve contract conditions "and veer away from the present degenerative trend."

Office Lighting

Recommendations in the new IES lighting code form the basis of suggestions for better office lighting by Mr W. J. Jones, M.SC., M.I.E.E., director of the British Lighting Council. Recommended levels of illumination are significantly higher than those applying in earlier codes, and a new feature is inclusion of a "limiting glare index" for various locations; 15 lm/sq ft is recommended as a minimum lighting amenity for all working areas, with values

Fig. 3. Mr J. G. Briggs listens as Mr L.C. Penwill reviews the history of the ECA. On the right is the new ECA president, Mr G. N. Walker

as high as 45 lm/sq ft at drawing boards and operating business machines.

Definition of the glare index is not attempted in the paper, but Fig. 4 shows how it operates for a representative type of office. With the limitation for normal office work to a glare index of 19, use of exposed batten fittings is ruled out altogether if sideways viewing is involved. Such generalisation must be treated carefully, however. The curves of Fig. 4 show that what is acceptable for a small room may be quite unacceptable in a large one. Taking classes of office one by one, Mr Jones comments that there is little technical difficulty in lighting a small office, say, up to 20 ft by 20 ft. As a rough guide 200 W of fluorescent lighting per 100 sq ft of floor area will usually provide 30 lm/sq ft under service conditions. Fluorescent lighting is likely to be particularly satisfactory—but "it should be clearly understood that any attempt to light other than a mere box of an office with a single fitting is bound to prove unsatisfactory."

In larger offices, specialist attention is needed if 30 lm/sq ft is to be provided with general comfort to the staff. Mr Jones urges contractors to take advice when planning for large areas, unless they have specialist staff engaged on illuminating engineering. Expert knowledge is required to keep the glare element down to the IES 19 index.

For corridors and staircases, the IES recommendations are 7 lm/sq ft and 10 lm/sq ft, respectively. However, for good lighting design, the important thing is to maintain a reasonable balance between lighting levels in offices and the corridors and staircases that serve them. Particular

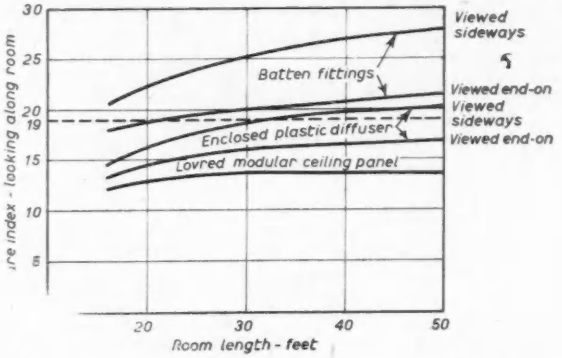

Fig. 4. Glare index for typical lighting fittings, related to a room 18 ft wide with fittings 10 ft above floor level. Reflection factors are ceiling 70%, walls 50%

attention should be given to lighting the treads without glare from light sources ahead.

Much is heard about daylighting of offices, but M Jones castigates the excuse "we have good daylighting" a an argument against the need for a good electric lightin installation. For a room with 2% minimum dayligh factor, which is better than most existing offices enjo some lighting is required for half the total working hou during the year to maintain 30 lm/sq ft. The proportio ranges from one-sixth for 10 lm/sq ft to unity (always-or for 60 lm/sq ft.

IES code values are not maximum. In some circum stances higher illumination levels are required. An exampl is use of permanent supplementary artificial lighting, whic permits deeper rooms to be used for a given ceiling heigh and the reduction of window glare at a cost of usin always-on lighting for part of the room. PSAL demands a illumination of about 50 lm/sq ft at the back of the room and this requires flush or near flush louvres with fluores cent lamps. Those enjoying 50 lm/sq ft in day time ar unlikely to relish a drop to 30 lm/sq ft at dusk, a facto which has to be kept in mind in planning. Much less tha 50 lm/sq ft has also been found to be disappointing whe relatively large luminous panels incorporated in the struc ture of the building are used for general illumination.

Looking to the future, an experiment where people coul select any value of illumination up to about 450 lm/sq f in relation to such office jobs as filing and typing, showe the average choice was to be 200 lm/sq ft. In Americ today's recommended level for office work is 100 lm/sq f to 150 lm/sq ft.

One effect of the higher lighting levels that needs to b noted is space heating. With fluorescent lamps, energy los in chokes and associated apparatus can be taken as abou 20% of lamp rating. Thus with an illumination level o 50 lm/sq ft, the heat from lighting may come to be tween 3 W/sq ft and 3½ W/sq ft, out of 12 W/sq ft t 15 W/sq ft of floor area required for space heating. Thi means that lighting provides about one-quarter of th necessary maximum heating.

Mr Jones ends with advice on how to get lightin business. His number one point is—invest in a lightmeter After that comes practicing what you preach by good lighting in your own premises, getting to know the IES code and taking part in "Office Lighting Week" planne for 23 October to 28 October.

Trading Co-operation

The discussion on trading problems and the scope fo co-operation was introduced by Mr S. F. Steward (director, BEAMA). After expressing his confidence in the future of the electrical industry, he went on to emphasise its unity. There were differences of interest and organisation between the component parts of the industry, but it was necessary to secure co-operation if all were to benefit to the maximum from the industry's expansion.

Mr Steward suggested that there might well be ways in which manufacturers, contractors and others could improve the effectiveness of the industry's joint promotional efforts. Also, each section of the industry had a duty to ensure that its activities were both progressive and profitable, so there was common interest in ensuring that the trading structure and commercial arrangements were fair and reasonable.

With Mr Steward on the platform were representatives of manufacturers of cables, lighting equipment, switch and fuse gear and wiring accessories. We hope to report in a later issue the discussion that ensued.

Direct conversion for specialised applications

by J. W. Gardner, B.Sc., Ph.D., M.I.Nuc.E.*

CONVENTIONAL generation techniques interpose a heat engine between the primary energy release and the electrical generator. The potential rewards in increased efficiency, reduced maintenance, etc., of generating electricity *directly* from the primary energy source are tempting enough to have stimulated a considerable volume of research into ways and means of achieving this desirable end. Although still requiring much development, four methods† have been brought to the state where they appear to offer real promise as power generators for the future. These have been the subject of previous articles in the ELECTRICAL TIMES,[1–4] to which the reader is referred for details.

The purpose of the present article is to make, as it were, a round-up of some of the less-publicised proposals for direct conversion which, although of marginal interest for large-scale commercial generation, appear promising for specialist applications requiring small units of high reliability in remote locations, e.g., space vehicles. The devices described are: the photovoltaic cell, the mechano-electric converter and the fission cell.

Just as in the case of the four "orthodox" methods of direct conversion, the successful exploitation of these more "off-beat" proposals will depend critically on the development of new, specialised materials, particularly semiconductors and other "solid state" materials.

Photovoltaic Cells

The discovery of the photovoltaic effect is usually attributed to E. Becquerel,‡ who in 1837 found that a voltage was developed when light was directed onto one of the electrodes in an electrolyte solution.[5] About 40 years later a similar effect was observed in a solid, selenium, by Adams and Day,[6] and exploitation of this discovery eventually gave us the photoelectric exposure meter that has become so important in photography. However, the efficiency of the selenium cell as a converter of light energy to electricity is less than 0·5%, which makes it quite hopeless as a practical power generator. The silicon solar cell, which came out of the Bell Telephone Laboratories in 1954 as a by-product of their transistor research, achieved a 6% conversion efficiency, which subsequent research has more than doubled; and from the theory of semiconductors we now know that a further doubling could, in principle, be achieved.

Before describing the *modus operandi* of the silicon cell it will be helpful to recall the essential characteristics of semiconductors, summarised in reference 2. As the name implies, a semiconductor has an electrical conductivity intermediate between that of a metal and an insulator. In a perfect insulator, each atom has exactly its full complement of electrons with none to spare; in a metal, on the other hand, there is a considerable excess of free electrons, viz., about 10^{23} per cu in. Semiconductors are classified into n-type and p-type; an n-type semiconductor contains about 10^{20} free electrons per cu in., whilst in a p-type there is a deficiency of electrons. The vacancies due to these missing electrons behave like free electrons with a positive charge, and are conventionally termed "positive holes," or simply "holes." A p-type semiconductor contains about 10^{20} such holes per cu in.

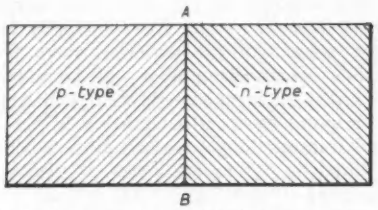

Fig. 1. Formation of potential barrier at p-n junction

Now if a p-type and n-type semiconductor are brought together, as in Fig. 1, a potential barrier is formed at the interface, analogous to the contact potential of two dissimilar metals. The value of this potential barrier can be calculated from thermodynamical considerations: it must be such that there is no net flow of electrons and holes across it in thermodynamic equilibrium. This equilibrium can be upset, however, if additional electrons and holes are generated so close to the barrier that they have time to diffuse across it before recombining to form neutral atoms. Such an electron-hole pair is created every time a valence electron of a neutral silicon atom acquires sufficient energy, e.g., by absorbing a light photon, to break free from its parent atom: for we then have one free electron and one atom-minus-an-electron, viz., a hole. The excess electrons will flow to the n-side of the potential barrier and the excess holes to the p-side, thus constituting an electric current. This current will be proportional to the number of photons absorbed per second (light intensity) and will continue to flow as long as light strikes the cell; the voltage will depend on the "height" of the barrier. Evidently, in order to create an electron-hole pair, a photon must have energy at least equal to the binding energy of the valence electrons, about 1·1 electron-volts in silicon. This "threshold" energy corresponds to a radiation wavelength of about 1·1 microns; the best response, however, is obtained from photons of somewhat higher energy, namely, about 1·4 electron-volts, corresponding to a wavelength of 0·8 micron (near infra-red).

In the actual fabrication of the silicon cell it is usual to start with a crystal of the n-type material and treat its surface with impurities to induce a p-type layer. To take

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† Magnetohydrodynamic conversion (separation of positive and negative charges in a gas); thermoelectric conversion (principle of thermocouple); thermionic conversion (principle of radio diode); fuel cells (separation of positive and negative charges during a chemical reaction).

‡ Not to be confused with A. H. Becquerel who shared with the Curies the Nobel prize for the discovery of radium.

advantage of its electronic properties the n-type silicon must be monocrystalline and extremely pure (impurity levels less than 1 part in 10^9). Wafers of this pure silicon are carefully ground, lapped and chemically etched, and then placed in a quartz tube furnace. Here, at a temperature around 2,300°F, a boron compound in gaseous form is passed for several minutes over the silicon, depositing thereon elemental boron which diffuses into the surface, creating a p-type layer less than 0·0001 in. thick. After the wafers have cooled, the p-layer is removed from the sides and rear surface so as to expose the original n-silicon. Suitable ohmic contacts are then attached to both sides of the p-n junction by means of appropriate plating and soldering techniques (Fig. 2).

In bright sunshine a silicon cell will generate about 0·6 V. Power output increases linearly with the radiation intensity but, because of the limited size of the cells which can be cut from a single crystal,§ the maximum output per cell is only about 20 milliwatts. Output drops off with increasing temperature, so modern cells are protected by filters which reflect away the unusuable radiations.

Recently, interest has developed in cadium sulphide as an alternative to silicon at higher temperatures.[7] The advantage of this substance over silicon is that its photovoltaic response falls off much more slowly with rising temperature, and for temperatures above about 300°F its conversion efficiency actually exceeds that of silicon.

Further improvements in the conversion efficiency of photovoltaic devices may result from ingenuity in design. For example, since different materials have their best response at different wavelengths, it may be advantageous to stack up layers of these materials in such a way that each would respond to a certain portion of the incident spectrum and transmit longer wavelengths, which in turn would be utilised by subsequent layers. If such a method could be perfected it would utilise the overall solar spectrum far more efficiently than silicon alone, giving efficiencies in excess of 20%.[7]

Even at its present state of development (10% to 15% conversion efficiency, 13 W/sq ft output) the silicon solar cell represents the best available means of providing small amounts of power for satellite communications, where transistorisation reduces the typical requirements below the 1 kW level. Moreover, these cells have indefinitely long life. The first US satellite to go into "permanent" orbit, Vanguard I, carried four small batteries of silicon cells when it was sent aloft on March 17, 1958. Thanks to these cells, it is still, at the time of writing, transmitting the results of its measurements back to earth. Besides its obvious advantages of long life and low weight,‖ the silicon cell actually delivers energy more cheaply than the conventional electrochemical batteries used in flashlights.[8]

Nevertheless, as large power supplies for ground stations, solar cells are still a long way from being economically interesting, and they have the further disadvantage of requiring a large collecting area. For example, a 10 kW generator suitable for a modern home power supply would occupy 100 sq yd and cost around half a million pounds!

The suggestion is made from time to time that photovoltaic cells might be used to convert the gamma radiation of nuclear reactors directly into electric power. This has always seemed rather unfeasible because of the likelihood of radiation damage to a cell exposed in the gamma flux of a large nuclear reactor. It is now possible to rule out the suggestion decisively, in view of the results of rece measurements[9] of the photovoltaic response of a numb of materials to gamma radiation. On the basis of the results, it can be computed that the electrical power outp from a given cell exposed to the gamma flux of a typic power reactor would be less than one-millionth of t output from the same cell exposed to bright sunlight.

Mechanoelectric Converters

Certain crystals, Rochelle salt for example, exhibit phenomenon known as the piezoelectric effect. When the crystals are subjected to compression or tension th opposite faces acquire electric charges of opposite sign, that the crystal becomes an electric dipole. When the stre is reversed the polarity of this dipole is reversed. If t crystals are vibrated at 10,000 c/s to 100,000 c/s an a power density as high as 50 W/sq in. may be generat at efficiencies as high as 90%. Familiar applications of th effect occur in gramophone pickups, hearing aids a vibration meters.

Besides the natural piezoelectric crystals there are certa man-made materials (e.g., the so-called ferroelectr ceramics) which can act as converters of mechanical electrical energy. The detailed physics here is somewh different from that of the piezoelectric effect, but th

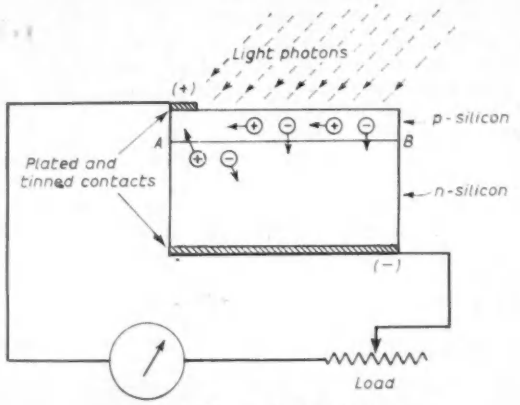

Fig. 2. Formation of photovoltaic cell

observable result is the same: applied mechanical stre results in electric displacement. Mention may also be mad of other materials in which electrical energy can obtained from the destruction by mechanical means stored-up polarisation (electric or magnetic). Here the ele trical output is determined by the stored energy rath than by the mechanical energy input. Such devices are interest for applications in which a single mechanical blo releases the stored energy, which then causes a voltag or current surge to operate a trigger circuit or spark ga

Apart from the small-scale applications already me tioned, mechanoelectric conversion seems to have receive relatively little attention. However, this appears to be du to a general lack of large-scale sources of mechanic energy of sufficiently high frequency, rather than to an inherent difficulty or inefficiency of the conversion proce itself.

Some proposals for medium large-scale mechanoelectr converters have been put forward by W. P. Mason, of Be Telephone Laboratories Inc.[10] In one suggestion the energ from a static water head generates vibrations in a wat column ("water hammer" principle); in another, a colum of gas is maintained in vibration by phased explosions petrol-air mixtures. In both cases the vibrations are tran ferred by a suitable mechanical transformer to piezoelectri crystals.

§ Typically 1 in. by 0·5 in. by 0·04 in. thick. Current development aims at increasing the area and reducing the thickness, since the active regions of the crystal are only a few millionths of an inch thick.

‖ Not low enough, however: considerable research is directed towards improving on the present figure of about 100 lb/kW.

Mason[11] has also given design-study details for a pilot model of the vibrating gas generator in which the piezoelectric crystals are replaced by a ferroelectric ceramic, permitting low frequency operation (about 2,000 c/s). This device is illustrated in Fig. 3. Gas from the fuel tank is atomised in the carburettor and sent into the input manifold from the pressure of the exhaust pipe. Its entrance into the explosion chamber is controlled by an intake valve whose displacement is in turn controlled from a solenoid operated from the electrical circuit. The gas explosion sets up a standing wave in the gas chamber which actuates a piston, causing the latter to press on the bimorph disc of ferroelectric ceramic as shown. The piston, spring and disc act as a mechanical transformer to transform from the low mechanical impedance of the gas to the high mechanical impedance of the ferroelectric ceramic. In order to keep all the vibrating energy in the cylinder the exhaust is taken out through an acoustic filter network which insures that the impedance to the vibrating energy is high while allowing a steady flow of exhaust gases.

For the dimensions shown, Mason estimated the output of this generator would be of the order of 1 kW. It was conjectured that the mean gas temperature in operation would be around 230°F. No estimate was made of the likely efficiency of conversion, and no indication was given of intent to proceed with construction of the device.

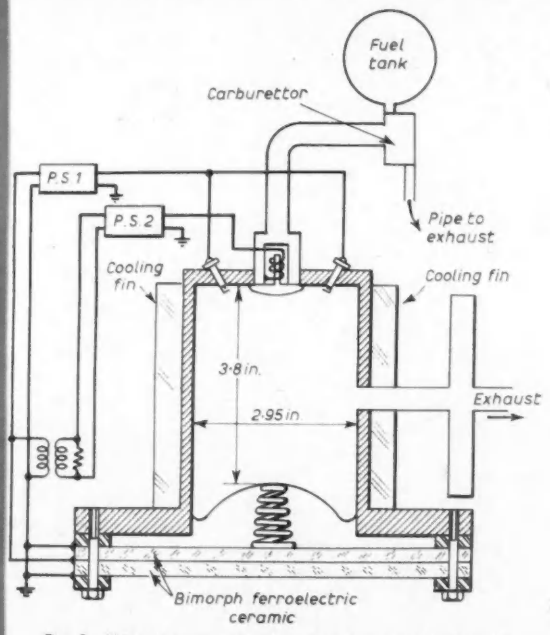

Fig. 3. Vibrating gas generator using ferroelectric ceramic

Other proposals have been made[1,12] for the direct conversion into electrical energy of the energy of an explosion. These however envisage gas temperatures of thousands, rather than hundreds, of degrees. At such extreme temperatures the gas becomes ionised and electrical power is generated as a result of its interaction with a magnetic field. This is therefore a special application of the MHD principle. One embodiment of this version of MHD, the plasma reactor, is described in reference 1.

Fission Cells

The fission cell is the name given to a device which has been proposed for converting the kinetic energy of charged fragments from nuclear fission directly into electrical energy. At the beginning of its path, immediately after fission of the parent nucleus, each of these fragments will have a positive charge of from ten to twenty times the magnitude of the electronic charge, and will be moving at about one-tenth the speed of light; typical energies of such fragments range from 50 to 100 million electron volts (MeV). As each fragment travels through matter it loses energy by several mechanisms (ionisation, electronic excitation, etc.), and in slowing down it gradually picks up electrons until all its positive charge is neutralised. In uranium metal the maximum range of a fragment, before it loses all its kinetic energy, is only a few ten-thousandths of an inch.

The kinetic energy of the fragment represents, of course, the bulk of the energy released at fission, and the idea of utilising it directly for electrical generation has offered a fascinating challenge to nuclear physicists and engineers ever since the first successful chain reaction was demonstrated, two decades ago.

The principle of the fission cell is extremely simple, and is illustrated schematically in Fig. 4. Positively charged fragments emitted by the nuclear fuel element A travel across the vacuum to the collector electrode B, where their kinetic energy is available to drive a current around the external circuit. The great practical difficulty, which has hitherto defied all attempts to construct a working cell, is the extremely short range of the fission fragments in the

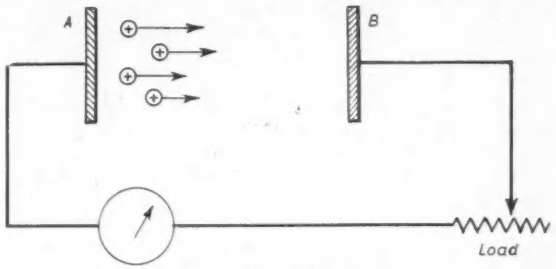

Fig. 4. Principle of fission cell

fuel element where they are produced. Because of this, most of the fragments are stopped within the fuel element itself and give up their energy as heat;¶ and practically none escape with sufficient energy to do any useful external work.

This difficulty appears to have been partially overcome by using extremely thin layers of the fissile isotope uranium 235, according to reports of some recent American experiments.[13] A cylindrical fuel element of 1·5 in. diameter and 3 in. active length was coated on its outer surface with 0·25 grammes of U235 and exposed to a thermal neutron flux of approximately 4 by 10^8 neutrons/sq cm/sec in the General Electric Test Reactor. A second, larger cylinder placed concentrically with the first acted as a collector for the fission fragments, and an axial magnetic field was used to suppress counterflow of electrons from the fuel layer. Fragment currents up to 1·7 by 10^{-10} A were observed, in good agreement with theoretical prediction.

The fraction of fission power converted to electric power in such a device depends on the operating voltage, the thickness of the fissile layer, and the ratio of the radius of the fuel rod to that of cylindrical collector. The latter ratio was 1·65 in the experiment described; the layer of U235 was about 0·0001 in. thick—sufficiently less than the maximum range of fission products to permit an appreciable number of them to escape. The open circuit voltage

¶ If this were not so the generation of heat in nuclear fuel elements would be an extremely inefficient process, and nuclear power reactors as we know them today would just not be possible.

ot the cell was about 4 MV and the maximum conversion efficiency, calculated as about 4%, was achieved at rather less than 2MV.

These investigations, which are still in progress, are aimed at the possible development of the fission cell as a power unit for space vehicles. The output of the cell described was less than a milliwatt and the project is evidently still very much at the demonstration-of-principle level. Nevertheless it is clear even at this stage that to achieve a reasonable power-to-weight ratio in a unit employing fission cells it will be necessary to operate at voltages in the MV range and use extremely thin layers of fissile material (only a few millionths of an inch thick if conversion efficiencies above 10% are to be achieved).

Summary and Conclusions

None of the concepts reviewed in the present article is in the same class of potential large-scale economic generator as the four direct conversion devices already described in references 1—4, viz.: MHD generators, thermionic and thermoelectric converters, and fuel cells.

As a small, long-lived power unit for space vehicles the silicon solar cell meets a specialised need, although it may shortly be challenged in this field by lightweight thermionic converters using solar energy. Most current research on photovoltaic cells is directed towards improving their efficiency by growing more perfect crystals and by experimenting with different materials. Cadmium sulphide has already been mentioned as having advantages over silicon at higher temperatures; another promising material receiving current attention is gallium arsenide. Some increased efficiency can be expected from these approaches, but probably no more than a factor of two. If a power-to-weight ratio much better than 50 W/lb is to be achieved, significant design advances will have to accompany the use of these new materials. There appears to be much room for improvement by using crystals in the form of very thin films, since the active region of the crystal is only a few millionths of an inch thick—a tiny fraction of the total thickness of the silicon wafers at present used.

The direct conversion of mechanical to electrical energy has been little explored to date because high powered, high frequency sources of mechanical energy are not in general use. Thus research on the feasibility of such sources, as well as improved ferroelectric and piezoelectric materials, will be an essential concomitant to any significant development in mechanoelectric converters. This method of conversion is unique in generating a.c. directly, although the thermionic converter, with certain modifications described elsewhere,[3,14] should also be capable of doing so. Other potential advantages claimed for the mechanoelectric converter are its relatively low temperature of operation and high power-to-weight ratio. Mason[11] conjectures 200 W/lb for the converter shown in Fig. 3, but this excludes fuel supply, the need for which puts it at a disadvantage compared with solar converters in space applications. Moreover, although it contains no rotating machinery, the fact that mechanical vibrations are essential to its operation presumably will necessitate a higher level of maintenance than in a completely static device.

The fission cell is still in the very early experimental stage. Although it may have an eventual development potential as a power unit for special applications such as space vehicles, its use in large-scale commercial generation seems remote, and unlikely to precede the replacement of fission reactors by fusion reactors for nuclear power generation.** Paradoxically, the direct conversion into electricity of the energy from controlled nuclear fusion would appear to present less difficulty;[16] in fact it looks as if we shall understand how to do this (e.g., by the MHD principle[1]) long before we have commercial thermonuclear reactors!

The author is indebted to the English Electric Co. for permission to publish this article.

** A more promising use of fission fragments is in chemonuclear reactors where, under fragment-irradiation, chemical changes are induced which would be impossible, or uneconomic, to achieve otherwise. The transformation of ammonia to hydrazine (a rocket fuel) appears feasible by this means.[15] This application, however, does not properly fall within the scope of direct electrical generation.

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N.C.B. IN 1960

DURING 1960 the National Coal Board produced 183·8 million tons of coal, while 202·4 million tons were consumed in Britain and by way of exports and ships' bunkers. These figures, given in the annual report of the Board for the year, represent an achievement of the NCB policy. As a result, stocks held by the NCB fell by about 6½ million tons.

During 1960 the cost of each ton of deep-mined coal sold increased from 82s 5d to 84s 5d, despite a reduction of 4d on the part of the cost (48s) attributable to wages and related expenses. The cost of opencast production was sharply lower, at 69s 1d/ton, although this, too, was up on 1959.

The financial outcome of the year was a deficit of £21·3 million after paying £41·5 million in interest. The NCB has not shown a profit since 1956. Capital expenditure during the year amounted to £85·7 million.

The report forecasts that, given steady industrial activity and normal temperatures, demand for coal should be the same during 1961 as 1960, while output from deep mines will be slightly down; so stocks should fall again. During 1960, 103 existing pits were being reconstructed and 13 new collieries built. Mechanisation and loading were much extended during the year and still faster progress is promised in 1961. Output per manshift for all workers was 27·9 cwt, showing further advance in productivity towards the declared target of 30 cwt to 31 cwt a manshift by 1965.

The supply industry took 51·1 million tons of coal in 1960.

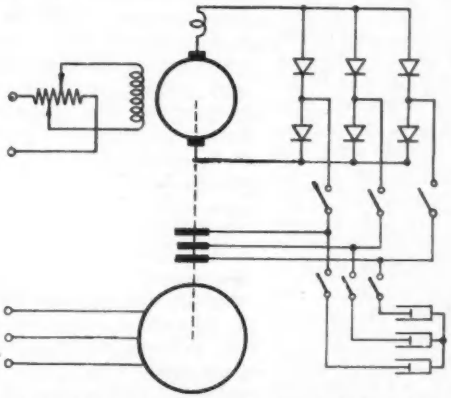
PROGRESS IN PATENTS

SELECTED SPECIFICATIONS

Slip-ring Motor Control

In a conventionally connected slip-ring induction motor the secondary currents induced in the rotor windings are usually dissipated as heat, either in the external resistances during starting and under variable-speed running conditions or in the windings when running with the slip-rings short-circuited. In Specification 868,763 the General Electric Co. of London describes an arrangement whereby the rotor currents are rectified and applied to a d.c. motor on the same shaft in such manner as to reduce the load on the induction motor.

The circuit is reproduced here and it can be appreciated that, by varying the field current of the d.c. motor, the speed of the induction motor can be altered, though, if the field current is reduced to zero, it will not be possible to raise the speed of the induction motor to the short-



This circuit gives speed and torque control for a slip-ring induction motor

circuited ring condition by reason of the resistive drop through the rectifiers. If, however, the field current of the d.c. motor is reversed, the back e.m.f. generated in the windings will aid, rather than oppose, that induced in the a.c. rotor and rectified, so permitting the motor to run up to its full normal speed. The arrangement, therefore, provides a simple and effective speed control for a slip-ring motor, the speed stability of which is ensured by a series winding in the d.c. motor field. For starting, a conventional three-phase starting rheostat is provided.

In an alternative embodiment, by a suitable switching arrangement not shown, the d.c. motor may be used as an exciter to supply the rotor windings with d.c., thereby converting the motor to synchronous running. Either semiconductor or mercury arc types of rectifier may be used.

Novel Refrigeration Cycle

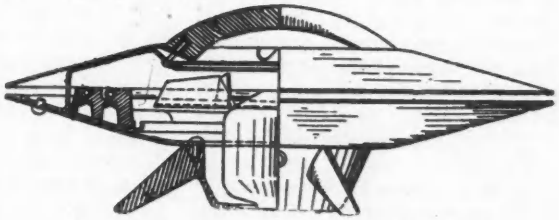
To date, three main principles of refrigerating process are common knowledge of which two are in wide usage, the so-called "absorption" principle and the gas compression/expansion cycle, while the third, using inverted thermoelectric elements, is just entering the early stages of practical development. Now Cleveland Pneumatic Industries, of Ohio, USA, describes an "improved" method in Specification 869,223, which is, in effect, a compression/expansion cycle carried out entirely in the liquid phase.

It is generally assumed that all liquids are incompressible and, for most practical purposes, they can be so considered. Some years ago, however, it was established that liquids under very high compression showed elastic properties, a discovery which was first applied with success to aircraft undercarriages by Dowty. Apparently Cleveland have now established that the compression is accompanied by rise of temperature and vice versa, enabling the liquid to be applied to a conventional compression/expansion refrigeration cycle in which, since the thermal expansion of a liquid is less than that of a gas, practically all of the compression power will be returned on expansion, apart from a very small mechanical loss in the compressor.

It is claimed that, because liquid is used as the refrigerant, smaller masses are required since liquids have a higher thermal co-efficient than gases and, because a given mass of liquid is smaller than the same mass of gas, the apparatus is also much smaller. The only drawback, as far as we can see, is that the liquid (acetone in the specification) is compressed to 20,000 lb/sq in.!

New Convection Heater

We have been having quite a spate of so-called tangential fan heaters on the market lately for some of which quite extravagant claims have been made. For the most part, they conform to a common pattern and, though he does not call his device a tangential heater, Kenneth Howes, of Kenilworth, describes, in Specification 869,579, what is undeniably an appliance in this class but one which is certainly more novel in concept.



A new concept in tangential flow convection heaters

As the illustration shows, it is a floor-mounted casing essentially comprising two dish-shaped circular pressings on a vertical axis enclosing a motor-driven impeller, also on a vertical shaft, which draws air in from a central grille on the upper surface and expels it tangentially through the vaned apertures on the periphery of the impeller and also through circumferentially placed heating elements, distributing it through a full circle between the two edges of the casing. In an alternative embodiment, the air is drawn from below the device with the motor mounted on the upper casing and is passed between heating elements, also circumferentially disposed, and the lower casing before being expelled through the space between the two casings. A switch on the upper surface provides a choice of heats and the control to the motor.

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Personalities *in the industry*

Mr E. V. Small

Mr G. N. Walker

Mr A. F. Burton

Mr H. G. M. Coleman

Mr W. J. Hume-Humphrey

Formerly a joint managing director of AEI Export Co. Ltd., **Mr E. V. Small** has been elected a director of Boving and Co., the water-turbine manufacturers with whom AEI companies have been associated in a number of hydro-electric schemes for many years. Last November Mr Small relinquished executive duties with AEI Export Co., since when he has been acting as consultant for them. At last year's BEPC he presented a paper on "Electrical Exports," a subject on which he is an acknowledged expert, for he has been concerned with overseas trade from almost his earliest days with BTH, Rugby, where he started as a student apprentice. From 1923 to 1931 he was with BTH (India) Ltd., then became a director of AEI (India) Ltd., of which he was managing director from 1935 to 1947. In that year he returned to England on being appointed director and general manager of the BTH Export Co., of which he was managing director from 1949 to 1959.

Mr D. C. Jardine has been appointed senior sales engineer for telecommunications products of British Insulated Callender's Cables Ltd., operating within the home sales organisation at Bloomsbury St. He joined the former British Insulated Co. in 1929, and after war service in the RNVWR returned to BICC as a sales engineer for telecommunication cables.

Mr Kenneth Lightfoot has resigned from the board of Lightfoot Refrigeration Co. Ltd. He has been with the company over 55 years.

Formerly director and general manager of the Witton works of the General Electric Co. Ltd. (he retired early this year), **Mr J. J. Gracie,** C.B.E., LL.D., M.I.E.E., has been elected president of the Birmingham Chamber of Commerce for 1961-62.

Director and secretary of Walker Bros. (Electrical Engineers) Ltd., of Birmingham, **Mr G. N. Walker,** B.SC.(ENG.), A.M.I.E.E., was elected president of the Electrical Contractors' Association at the annual conference on Monday. He also becomes president of the allied organisations, NECTA and the NFEA. He thus follows in the footsteps of his father, the late Mr H. E. Walker, who was ECA president in 1938-39. Mr G. N. Walker received practical training in his father's firm, Walker Bros., and became secretary in 1929. Following war service he returned to the family's business as director and secretary. He joined the ECA in 1928, and with the Birmingham branch served as treasurer from 1935 to 1939 and chairman from 1945 to 1947. He has served on the ECA Council since 1954. A new vice-president of the Association is **Mr H. F. Truman,** of Truman Electrical Co. Ltd.

Senior plant sales engineer with Crompton Parkinson Ltd. since 1950, **Mr P. A. Adams** has joined the Electric Construction Co. Ltd. as an area sales engineer, operating from the London office. He served his apprenticeship with British Electrical Repairs Ltd., subsequently joining Woodall-Duckham, and in 1933 he joined the Sturtevant Engineering Co. Ltd. where he was latterly chief electrical engineer. Before joining Crompton Parkinson he had a brief period with Hopkinson Electric Motors.

Mr G. H. Greenhalgh, of the UKAEA, has been appointed nuclear energy attaché to the UK delegation to the European Communities, succeeding **Mr D. H. Hill,** who is taking up a post with the Authority's Reactor Group.

Previously sales manager of Exactor Ltd., **Mr A. A. Haining,** A.C.I.S., A.S.M.A., has joined Simon Equipment Ltd. as sales manager. **Mr H. Powell,** formerly of the Plessey Co., has also joined Simon Equipment as production manager.

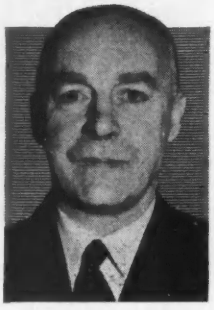
The formation of a new company HMV Domestic Appliances Ltd., which is to market all HMV appliances from 1 July next, is noted on page 922. Three chief officers appointed are: general manager and chief executive, **Mr A. F. Burton;** commercial manager, **Mr H. G. M. Coleman;** and sales manager **Mr W. J. Hume-Humphreys,** who will have under him five regional managers. Mr Burton was previously general sales manager to Charles Colston Ltd., and a director of their subsidiary, Tallent (Aycliffe) Ltd. Previous to that he was in sales management with Hoover Ltd. Mr Coleman was previously in sales management with Charles Colston Ltd., being at one time their senior training manager, and earlier was with Hoover Ltd. Mr Hume-Humphreys has been with the Gramophone Co. for some time, following experience with Rank group.

Retiring after over 50 years' service with the company, Mr C. F. Hutley (left), West End representative for Edmundsons Electrical Wholesalers Ltd., was presented with a powered lawn mower and a cheque by Mr J. T. E. Lodge (Middlesex representative) on behalf of his colleagues

Sir Robertson King to retire—Mr. R. S. Edwards new chairman

Sir Robertson King

Mr R. S. Edwards



Mr C. T. Melling

Chairman of the Electricity Council, **Sir Robertson King,** K.B.E., COMP.I.E.E., M.INST.F., is to retire on the termination of his present period of office on 31 Dec. next. His successor will be **Mr R. S. Edwards,** D.SC.(ECON.), who is now a deputy chairman of the Council. The Minister of Power has also appointed **Mr C. T. Melling,** C.B.E., M.SC.TECH., M.I.E.E., M.I.MECH.E., M.INST.F., F.B.I.M., to be deputy chairman of the Council on the retirement of **Sir Josiah Eccles,** C.B.E., D.SC., M.I.C.E., M.I.MECH.E., M.I.E.E., at the end of July (*ESH, page 45). Sir Robertson King has served in the electricity supply industry since 1919. He was with the Derby and Notts Electric Power Co., of which he became manager in 1932, and six years later was appointed deputy general manager of the power companies controlled by the Midland Counties Electric Supply Co., of which he was promoted to general manager in 1940. From 1948 to 1957 he was chairman of the East Midlands Electricity Board, then deputy chairman of the CEGB and in September, 1959, succeeded Sir Henry Self as chairman of the Electricity Council. Mr Edwards has been a deputy chairman of the Council since its formation in 1957. Previously he was professor of economics, with special reference to industrial organisation, in the University of London. He was a member of the Herbert Committee which recommended the reorganisation of the administration of the industry and the formation of the Electricity Council. Earlier, he had been a member of the Clow Committee which reported on peak loads in relation to non-industrial consumers. Mr Melling has been a full-time member of the Council since its formation in 1957. Earlier he was chairman of the Eastern Electricity Board from its inception. His association with the supply industry dates back to 1934—when he joined the Yorkshire Electric Power Co.—but he had previously served with Metropolitan-Vickers Electrical Co. for 14 years. He was personal assistant to the general manager of the Edmundsons Electricity Corporation from 1934 to 1943 when he became borough electrical engineer at Luton, a position he held till 1948. A past-president of the ASEE, he has also served as chairman of the ERA Council, of the EDA Council, and of the IEE Utilisation Section.

Mr J. T. Moorhouse, A.I.A.C., and **Mr W. H. Harding,** A.M.I.E.E., have been appointed directors of Austin Taylor Electrical Ltd. Mr Moorhouse, the company secretary, has been associated with the electrical manufacturing industry in the north west for 20 years. Mr Harding has been district engineer in the Manchester area for A. Reyrolle and Co. for the past 15 years.

Mr W. H. Connolly, B.E.E., B.COM., M.I.E.(AUST.), has been reappointed chairman of the State Electricity Commission of Victoria, Australia, for a further period of five years—a position he has held since 1956. Mr Connolly, who has served with the Commission for nearly 40 years, is to attend the meeting of the International Executive Council of the World Power Conference (of which he is vice-chairman) in Moscow next month. As chairman of the Australian National Committee he will act as host at the sixth plenary meeting, in Melbourne next year.

Mr J. T. Moorhouse

Mr W. H. Harding

Mr W. H. Connolly

Mr G. Short, dealer liaison manager of Hoover Ltd. for the Midlands Electricity Board and the East Midlands Electricity Board areas, is retiring at the end of June after 35 years' service.

At present district engineer, Southern District of the London Electricity Board, **Mr A. H. Lowman,** A.M.I.E.E., has been appointed manager of the Board's Western District in succession to **Mr J. Brocklebank,** M.I.E.E., who is to retire at the end of July (*ESH, pages 79, 82). Mr Lowman, who takes up his new duties on 1 Aug., has held his present position since 1957. Prior to that he was with the Southern sub-area as operation and maintenance engineer, a position he had held since 1948. Prior to nationalisation of the industry he served with the South London ES Co.

Secretary of the General Electric Co. Ltd. since 1955, **Mr T. B. Ellis,** F.C.C.S., has intimated his wish to retire on 30 June next. He is being succeeded in that position by **Mr A. M. Parsons,** F.C.A., who will be released from his duties with the Esso Petroleum Co., from 17 July next. Mr Ellis joined GEC in 1949.

The General Electric Co. has also announced that from 1 July **Mr C. S. P. Mallam,** C.A., formerly chief accountant, is appointed Controller, and **Mr B. E. Davey,** previously deputy chief accountant, is promoted to chief accountant.

Mr F. H. Ewens, chairman and joint managing director of W. Canning and Co., relinquished the joint managing directorship last Thursday, but continues to be chairman. **Mr W. H. Griffin,** formerly joint managing director, has been appointed deputy chairman and becomes sole managing director. **Mr L. G. Mummery,** director and secretary, has relinquished the office of secretary and becomes assistant managing director. In addition, **Mr D. Paddon-Smith** has been appointed to the board in place of **Mr S. S. Dawson,** who has retired, and **Mr J. M. Stevens** has been appointed secretary of the company.

**Denotes revision to the "Electricity Supply Handbook, 1961."*

Mr H. C. Fox

Mr T. Blythe

Mr L. A. Thomas

After 47 years' service with George Ellison Ltd., **Mr H. C. Fox,** M.I.E.E., has retired. He has represented the company on the Electrical Research Association for some 20 years and for a period was a member of their Switchgear Committee G/XA. His services to the electrical industry also include past membership of the BEAMA switchgear and ASTA technical committees and he is still a member of the ASTA management committee. A past president of the Birmingham Electric Club, he has also served on many IEE committees. In addition to being a member of the Utilisation Section and South Midlands Centre main committees, he was chairman 1953-54 and secretary for the past six years to the Supply and Utilisation Section Committee. Educated at Waverley Grammar School and the Birmingham College of Technology, Mr Fox joined the Ellison drawing office in 1913, later serving in the Testing Department. In 1920 he was appointed personal assistant to the late Mr J. Anderson, and in 1926 was made responsible for the design and development of high voltage switchgear. From 1937 onwards he planned and laid out the "Ellison" ASTA authorised testing station and was appointed successor to Mr Anderson in 1950.

Previously with S. N. Bridges Ltd., **Mr T. Blythe** has joined Aircraft-Marine Products (GB) Ltd. as general sales manager. He will be responsible for sales policy of the British company. As general sales manager of S. N. Bridges, Mr Blythe had overall responsibility for domestic appliances and electric tools. He had been with that company for nine years, moving to the main Battersea factory in 1958, after three years as Bridges' Midlands sales manager. Earlier he had been with E. R. Howard Ltd., and Chloride Batteries Ltd.

Previously supervisor in the South Wales area, **Mr C. V. Griffiths** has been promoted to area sales manager of Kenwood Electrics Ltd., Droitwich.

Membership of the Ipswich and District Electrical Association is steadily increasing and now stands at 178, **Mr R. L. Thurlow,** the retiring chairman, stated at the annual general meeting last week. **Mr H. V. Pugh,** chairman of the Eastern Electricity Board, was re-elected president, and **Mr R. W. C. Stebbings,** chief commercial manager, Suffolk subarea, EEB, is the new chairman, with **Mr H. H. Wright,** of AEI Ltd., Ipswich, vice-chairman.

Wayne Kerr Laboratories Ltd. have appointed **Mr J. O. Viccari** as manager of their headquarters sales office at Malden.

Atlas Lighting Ltd. announce that **Mr L. W. A. Davis,** previously their chief designer at George Forrest, has been appointed Atlas special design consultant and has now moved to the Lighting Fittings Department at Thorn House.

Mr J. W. Smith has been appointed sales supervisor at the Glasgow office of Atlas Lighting Ltd. He has been a commercial lighting engineer with the company since September, 1959, and is succeeded in the latter position by **Mr W. Clark.**

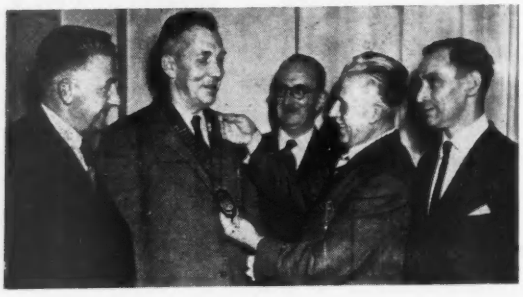
Mr L. A. Thomas, B.SC., F.INST.P., A.M.I.E.E., has been appointed chief physicist at the Hirst Research Centre of the General Electric Co. Ltd., Wembley. He will be a member of the staff of the Central Research Laboratories with special interest in the programmes of long-term and fundamental research. Mr Thomas, who is 44 years old, joined the GEC's Research Laboratories in 1935. He became head of the Materials and Components Division in 1960 and retains his responsibilities in this field of the work of the Centre.

Mr M. A. Craig, of Electrolux Ltd., has been elected chairman of the Domestic Refrigeration Development Committee in place of the late Mr E. G. Rowledge. Mr Craig was formerly vice-chairman, a position to which **Mr W. Roxburgh,** of Morphy-Richards Ltd., has been elected.

Mr F. M. W. Hird, secretary of Frederick Smith and Co. (Wire Manufacturers) Ltd., has been elected president of the Institute of Cost and Works Accountants.

Mr A. H. Campbell has been appointed joint managing director of Hilger & Watts Ltd. with Mr G. A. Whipple. Mr Campbell has been a director of the company from 1951, and general manager since 1954.

Mr F. D. Bolt, B.SC.(ENG.), M.I.E.E., has been appointed head of the BBC's Transmitter Equipment Section, Planning and Installation Department, in succession to **Mr D. B. Weigall,** M.A., M.I.E.E., who has been transferred to the staff of the senior superintendent engineer, external broadcasting.



Mr R. W. C. Stebbings, the new chairman, IDEA, receives the badge of office from Mr R. L. Thurlow, retiring chairman. Looking on are Mr W. F. Rowberry, hon. sec. (left), Mr W. H. Howell, hon. treasurer (centre) and Mr H. H. Wright, vice-chairman

OBITUARY

Mr R. C. Taylor, chairman of Santon Ltd., died on 31 May, aged 81. He was one of the founders of the company, and for many years the sales director. He had been chairman since 1953.

Mr Geoffrey Parr, M.I.E.E., who was honorary secretary of the Television Society until retiring in April, died on 30 May.

Dr W. R. C. Coode-Adams, M.A., M.SC., PH.D., F.R.I.C., M.I.E.E., who was principal of Faraday Hse Technical Training College from 1937 to 1957, died on 31 May, aged 66. In 1958 he went out to India as principal of the Technical College at Patiala. To all Faradians he was a very familiar figure, for he started there as a lecturer in 1925, and after a short period at Cheltenham Technical College became head of the Chemical Department in 1929 and deputy principal in 1936. He returned from India a few weeks ago.

Mr E. Hyman, deputy chairman of the Southern Electricity Consultative Council, has died, aged 60.

Mr F. Shakeshaft, O.B.E., A.M.I.E.E., M.INST.F., formerly station development engineer to the Central Electricity Authority, died on 17 May.

U.S. looks at switching surges

HIGH TRANSIENTS FROM CHARGED LINE RECLOSURE

IN our continued summary of papers presented to the American Power Conference,* we consider papers dealing with investigation of switching surges carried out on a miniature system and computer analysis of long-term power system development.

Investigation of switching surges carried out on a miniature transmission system are discussed in the paper, "Switching surges due to energisation or reclosing," by Messrs I. B. Johnson, R. F. Silva and D. D. Wilson (GE, Schenectady). For many years, engineers have been concerned with ensuring adequate protection against short-time lightning impulses and meeting high-voltage test requirements. Improvements in providing protection against lightning have made possible use of lower insulation levels with closer tolerances. However, as insulation levels have been reduced, switching surge protective levels of arresters have remained essentially the same; in consequence, attention has been directed, more and more, to the nature of the more common switching surges.

Recent full-scale tests have shown that simple extrapolation of clearances from lower voltage to e.h.v. systems is not reliable because of non-linear flashover effects; that 60 c/s and switching surge strengths depart from linearity, particularly under wet conditions or for dry positive polarity surges; that, often, the minimum switching surge strength differs little from the wet 60 c/s crest value; and that in many instances the wet switching surge strength is actually lower than the wet 60 c/s crest strength.

An important part of the investigation has been concerned with reclosure of a circuit when charges are trapped on the lines, a condition of great importance with modern high-speed auto-reclosing. Surge voltages produced by current chopping or when transformers are demagnetised have largely been overcome by improved design of circuit-breakers and by the use of modern core steels.

Surges at Transformers

Attention is now being devoted to the more usual surges occurring when lines with connected transformers or other apparatus are energised and de-energised. Transient analyser studies have shown that these surges may exceed the commonly believed maximum value of twice the normal line-to-neutral crest voltage. It has also been observed that surge arresters frequently operate when a line terminated in a transformer is energised and that such surges can be as severe as those associated with a restrike when a circuit is interrupted. Operating experience has shown that when an auto-transformer interconnects two transmission circuits operating at different voltage levels, sparkover of the transformer h.t. arresters may occur when the high-voltage line is energised at the end remote from the auto-transformer, and with the c.b. on the low-voltage side of the auto-transformer open.

The miniature system used in the investigations had adjustable synchronous switches to enable closing of the phase contacts to be varied within one half cycle. Various source reactances could be inserted to represent station short-circuit capacities at different voltage levels and linear reactances connected in the transformer neutral gave a range of zero impedance values. The model transformers had characteristics corresponding to those of full-scale units.

Tests made without a transformer at the receiving end of the miniature line showed that, with the first phase energised near voltage maximum, transient voltages of 2·5 p.u. to 3 p.u. of the nominal phase-neutral crest voltages occurred, depending on the length of line.

The phase switches were arranged to close so that, with the first phase energised at or near maximum voltage, the switches in the other two phases closed on the induced coupled voltage transient and within 180° of the first phase closure. The point of closing was adjusted to give maximum ground-to-line transient voltage at the receiving end of any phase line.

With a transformer connected at the line receiving end, the transient was found to be unaffected by transformer saturation, but it was affected by the zero-sequence impedance to a small extent. Maximum transient voltages in excess of 3 p.u. were obtained with the line terminating in a transformer, the voltage increasing slightly with line length and also with terminating transformer zero-sequence impedance. Thus, with a transmission line reactance ratio $X_0/X_1=4$, a line 50 miles long had a transient voltage of 2·2 p.u. with a transformer zero-sequence impedance of 25 ohm, rising to 2·8 p.u. with an impedance of 350 ohm. Corresponding p.u. values for a line 200 miles long were 2·75, rising to 3·5.

Trapped Charges and Reclosure

To investigate the effect of trapped charges, the miniature system lines were interrupted so that two phases had charges corresponding to line-to-neutral crest voltage

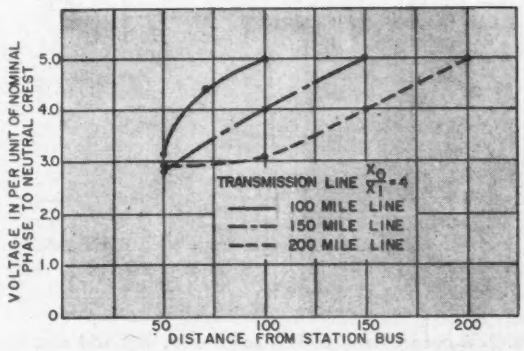


Fig. 1. The effect of re-energising a long line with trapped charges. Maximum transient voltage on an unfaulted phase shown as a function of distance from the reclosing breaker, for various lengths of line

* All papers summarised were presented at the 23rd annual meeting of the American Power Conference. The report of the Conference proceedings will be published in the USA in November.

and the third phase was left with a charge of opposite polarity. After several cycles, the line was reclosed at the sending end when the source voltage was at crest value, but opposite in polarity to the trapped voltage on the line. Subsequently, the other two phases were reclosed, within 180°, to give maximum transient voltage on the first phase. The tests showed that, if the performances of a faulted and an unfaulted phase were compared, transients on unfaulted phases were generally greater at any given distance along the line and that the maximum value of these transients might be 3 p.u. to 5 p.u. of the nominal phase-neutral crest voltage. The maximum value of the voltage transient was found to be independent of fault location, but it increased with distance from the reclosing c.b. None the less, the actual maximum values recorded along lines of different length were the same and appeared to be independent of line length. On a 100-mile line the maximum reclosing transient decreased with increasing source reactance up to a value of 50 ohm and then remained fairly constant for larger ohmic values.

System Planning by Simulation

Planning the growth of a bulk power system over a 20-year period to make the most of the installed equipment has been studied by mathematical and logical models in conjunction with a digital computer. In his paper, "Results of long-range planning by simulation," Mr C. J. Baldwin (Westinghouse Electric Corp., East Pittsburgh), shows that, with the assumptions made, the gas turbine has considerable economical advantages for providing peak power and that for base load generation, units of 1,000 MW are about the most economical. If the size of generating units exceeds 1,000 MW, the additional transmission costs, at least for the systems considered, begin to outweigh the economies possible with very large generating units.

The technique is to use mathematical and logical models to represent different aspects of system operation and

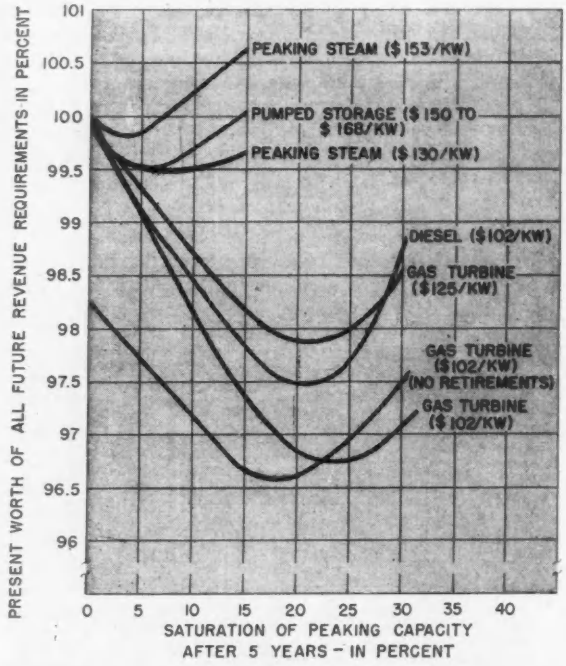


Fig. 2. A comparison of peaking power costs. The total cost, over a period of 20 years and assuming a unit life of 47 years, is plotted against the percentage saturation after five years, that is, the ratio of peaking plant to the total plant installed

expansion. Power system load growth is simulated by one model and generating capability by another. The two models combine to give simulated reserve margins, which can then be used, with a uniform measure of reliability, to determine new generator installation dates. The digital computer installs the new plant according to pre-programmed rules and then continues the simulation over the 20-year period. Transmission expansion is included in the calculation.

Since future costs are uncertain, system growth must be studied for a variety of eventualities. For example, different estimates of unit costs may show greater benefits from increasing their size. They may also vary in the allowance made for heat rates in the larger units. Allowances are also made in the study for whether the site is existing or has to be developed and the time which separates installations on the same site.

Production expenses are allowed for fuel, operation and maintenance, the cost of fuel being dependent on kWh generated and anticipated load factor. All costs are based on estimates for the year 1958 and do not take account of inflation or similar effects over the study period considered. For the systems considered, the costs of generating stations, switchgear and transformers were included.

The studies show that, irrespective of the cost structure assumed for the calculations, large units are economical, with systems including units of 1,000 MW giving optimum costs for the interconnection and the outage rates assumed. Although transmission costs account for only 6% to 7% of all estimated future costs for a given system, they become significant in the choice of the unit size and cause a rise in costs for units above 1,000 MW. If this effect of rising transmission cost was not apparent, optimum unit size would exceed 1,500 MW, although saving rates decrease considerably as the size of unit increases. Large unit economy depends vitally on the outage rate and would disappear if, for example, the national average rate of 2% outage assumed for 1,000 MW units in the studies increased significantly.

New units are installed to maintain a consistent service to the consumer, but too severe a level of reliability results in very high costs since greater reserve generating capacity is required. On the other hand, a system with poor reliability can be raised to an acceptable level at relatively moderate cost.

Economics of peak power

The paper considers the relative merits of providing peak power from gas turbines, diesels, pumped-storage plant, spinning reserve turbines and low-cost peaking steam plants. In the simulation, retirement of old units is assumed at 47 years and both seasonal factors and load duration curve shapes are changed at five-year intervals.

Maximum saving occurs if after five years 20% of the plant is gas turbines, showing that a substantial saturation of peaking plant is economical. The most important consideration is the difference in capital cost between peaking plant and its base load alternative. Maximum economies are shown by the low-cost gas turbine for providing peak power. The spinning reserve advantages of diesels are not sufficient to offset their increased operating cost when compared with gas turbines. However, they are the next most economical type of plant for providing peaking capacity. Costs of peaking steam and pumped-storage plants are not only considerably higher than for gas turbines and diesels, but their economical proportion of the total generating capacity installed is much less.

HMTS "Alert" on the measured mile

G.P.O. USE NEW CABLE SHIP FOR ATLANTIC CABLE

LATEST addition to the GPO cable-ship fleet, 4,200-ton HMTS *Alert*, has now been completed ready for service in the North Atlantic. For her first assignment she is bound for the St. Lawrence estuary with 400 miles of light-weight submarine telephone cable on board. This she will lay to form a stage in the CANTAT UK-Canada telephone link. Cable-laying operations demanding a vessel of extreme manoeuvrability, *Alert* is twin-screwed with diesel-electric propulsion and all-electric auxiliaries. To assist steering, she is fitted with a bow propeller, while a comprehensive array of the latest radio and radar aids ensures pin-point navigation under all weather conditions.

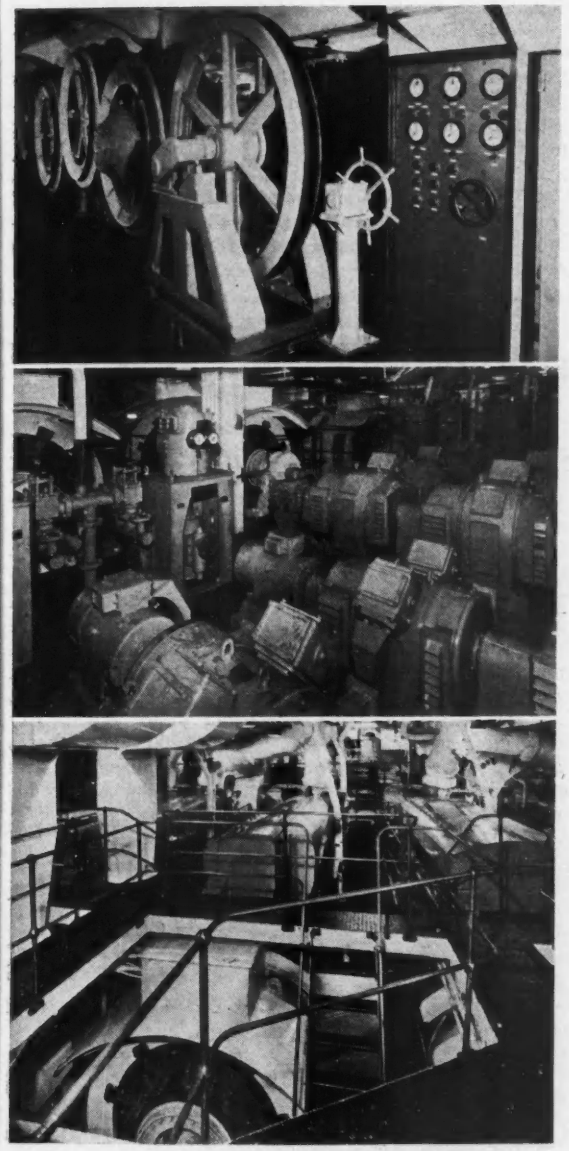
Main Propulsion

Giving her a top speed of 15 knots, *Alert* has two d.c. propulsion motors, each developing 2,200 s.h.p. at 120 r.p.m., with a terminal voltage of 660 V. These motors, together with all other propulsion and auxiliary machines, were supplied by AEI. Main prime movers consist of four Mirrlees eight-cylinder marine diesel engines, each providing an output of 1,860 h.p. at 428 r.p.m. These drive four 895 kW, 335 V main propulsion generators tandem-coupled to 300 kW auxiliary generators. There are, in addition, two other auxiliary generators rated similarly, but driven by separate Mirrlees diesel engines.

Constant Current Control

For control purposes, there are two propulsion circuits. Each propulsion motor is connected in a series loop with two main generators. To ensure maximum speed of response to movement of the controller and to give constant propeller torque for any particular controller setting, a "constant current" system has been adopted for the *Alert*. The system makes use of amplidyne exciters for motor and generators in each series loop circuit. These amplidynes are tandem-coupled to a voltage reference generator, the three machines driven by a motor and making a single exciter set. A third such exciter set is installed as a standby.

A single amplidyne exciter supplies the two parallel conected fields of each pair of propulsion generators. This amplidyne has three field windings, one being fed from the reference voltage generator via the propulsion rheostat controller. In opposition to the reference field is the feed-back control field connected across the interpole winding of the propulsion motor. For any particular controller setting, interaction of the amplidyne exciter fields effectively maintains constant current in the loop circuit, and hence constant motor torque, despite any variations in propeller load. The third amplidyne field winding is connected in series opposition to the output from a tacho-generator driven by the propulsion motor. This protects



Top: Telcon cable laying machinery installed aft of HMTS "Alert."
Middle: Amplidyne exciter sets for constant current propulsion control.
Bottom: Engine room on "Alert" showing one of four AEI propulsion generators. Mirrlees diesel engine prime movers in background

the motor from overspeeding by automatically reducing the voltage output of the propulsion generators.

To guard against generator overloading, a "swamping" winding on the propulsion motor amplidyne effectively limits the power output of the propulsion motor to the maximum generator rating. In addition, this arrangement permits sudden switching out of one of the pair of series propulsion generators without overloading the generator remaining in circuit. It also prevents overspeeding of the diesel prime movers when propulsion motor fields are abruptly reversed during manoeuvring.

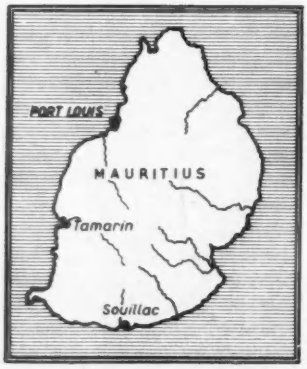
Bow Propeller

Constant current control is also a feature of both the Voith-Schneider bow propeller and cable-handling machinery aboard the *Alert*. Housed in an athwartship tunnel, the bow propeller is a variable-pitch, constant-speed device, developing up to 2·5 tons side thrust. It is driven by a 200 h.p. d.c. motor connected in a series loop with an auxiliary generator, both machines being amplidyne excited. The arrangement gives constant torque from stand-still to full propeller speed. As in the case of the main propulsion circuits, propeller overspeed is limited by means of tacho-generator control. This is an essential feature during operation in rough seas liable to expose the propeller and cause it to race.

Although the more publicised duties of *Alert* will be in laying of new submarine cables, no less important will be her role in repair and maintenance of existing cables. She has thus been equipped, by BICC (Telcon), with two types of cable-handling gear. Maintenance cable recovery and replacement is carried out over the bows of the ship. For this purpose there are a pair of "picking-up" and "paying-out" cable engines installed forward, at port and starboard. These were specially designed to handle light-weight, armourless cable. Each is driven by a 250 h.p. AEI motor, series connected to a pair of the tandem-coupled auxiliary generators; once again, use is made of the constant current, constant torque system. The arrangement enables regenerative power developed when paying out cable to be fed back to the tandem auxiliary generators, thus assisting the propulsion generators which are on the same shaft.

Aft of the ship, five-sheave machinery for laying new cable is installed. Special feature of this gear is that it is designed to handle cable having rigid repeaters already jointed in. These section the cable at about 30-mile intervals. During paying out, each repeater is carried on a trolley to traverse the ship's deck and arranged to by-pass the paying-out sheaves. Here, again, power is provided by a 250 h.p. motor with provision for regenerative feed-back to the propulsion drive. During cable-laying or lifting operations, precise monitoring of cable tension, slack, paying-out speed and length is essential. Such data is fed from dynamometers, tachometers and similar instrumentation to the cable control room, from which operations are directed.

POWER FROM THE SEA FOR MAURITIUS

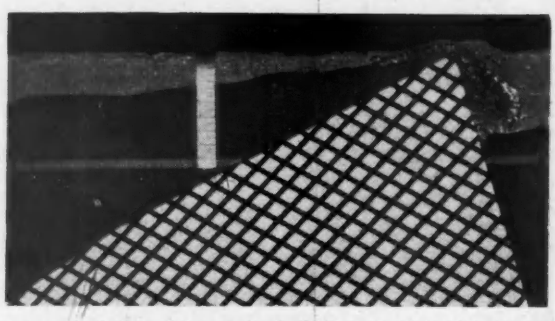


THE Island of Mauritius, set in the Indian Ocean some 1,500 miles east of Durban and about 550 miles from Madagascar, is an isolated colony with a population of about 640,000 in an area of approximately 805 square miles. It has an expanding electrical demand satisfied by a complex system of small diesel, steam and water-power stations operated by the Central Electricity Board of Mauritius under the General Manager, Mr A. N. Bott, M.I.E.E., F.R.S.A.

Operation of the system is rather complicated in that, because of porosity of the substrata, rainwater cannot be stored. Consequently, hydro-stations take base load only during the rainy seasons with other stations handling peaks while, in the dry seasons, the position is reversed. The island is, therefore, keenly interested in any proposition which would give year-round generation with, preferably, a natural source of power.

Among the projects considered by the Board has been one for utilising power from the sea, not as a purely tidal project, since the rise and fall of the tides in this part of the Indian Ocean is small, but by using the almost constant succession of rollers, 4 ft to 12 ft high, which break on the southern shores of the island. It has been proposed to impound the waters in a shallow lagoon in the vicinity of Souillac and to guide the rollers up a concrete ramp into the lagoon. The impounded waters, with a head of 10 ft to 12 ft, would then be released through low head turbines. It has been estimated that such a scheme could be used to generate about 9,250 kW initially and possibly an ultimate total of 44,000 kW.

Sir Alexander Gibb and Partners were asked to investigate the project and they secured the assistance of the DSIR in setting up a series of models at the Hydraulics Research Station, Wallingford, on which the performance of simulated rollers ranging from 2 ft to 10 ft at intervals from 6 sec to 10 sec were studied on a 1:15 scale. Equipment has now been installed on the island to measure actual height and frequency of the waves. This is a new approach to conserving the ocean's energy which will be watched with interest by engineers all over the world, particularly now that the Passamaquoddy scheme has been shelved.



Photograph of the model set up by the DSIR at the Hydraulics Research Station. Waves set up in the tank on the left, representing the ocean, gain crest height as the artificial sea bed (hatched) shallows, finally surmounting the top of the ramp to be impounded in the lagoon on the right

Supply in Northern Ireland

COOLKEERAGH REDUCES GENERATION COSTS

ADVANTAGES resulting from further commissioning in the power station at Coolkeeragh enabled material reductions to be made in generating costs, and these have largely been passed on to the consumers. The annual report of the Electricity Board for Northern Ireland for the year ended 31 December, 1960, discloses that total unit charge reductions of nearly £330,000 were passed on to consumers, representing approximately 5½% of the total revenue from sales. For consumers with relatively high load factors, the price reduction was as high as 8% to 10% per unit. The reductions were made possible partly by lower generating costs of the Coolkeeragh oil-burning station and partly by amendment of the fuel clause.

With the Coolkeeragh station capacity being increased by a further 60 MW in November this year, the Board have decided to further amend the fuel clause to give an additional overall reduction in consumer charges of approximately £50,000, taken over a year, at some date during the current year.

Sales of energy rose no less than 25·4% above the previous year to 768 million units, but this increase was, in the main, attributable to two large industrial users. Nevertheless, the remainder of the system showed a load growth of 13% compared with 9·2% during 1959.

The total gross income for the year was £5,997,424, an increase of 12% on the previous year, and the number of consumers also rose appreciably from 172,240 to 178,867. Expenditure rose slightly more than income by 14% to £4·7 million, and the accounts for the year show a balance of £42,004.

Installed capacity at Coolkeeragh rose to 60 MW in June with the commissioning of the second 30 MW set, and the station operated at a load factor of 45·2% with a maximum load of 59·85 MW. Maximum load at Ballylumford station was 117·5 MW and the load factor was 32·1%. The Board's station at Larne was not used during the year. Contracts were placed for a second 60 MW at Coolkeeragh, which is scheduled for commissioning in the winter of 1963-64.

In the field of transmission and distribution, about two-thirds of the Londonderry Corporation's 3·3 kV system was changed over to the 6·6 kV supply from Coolkeeragh. Work was also completed on an additional 110 kV interconnector from Ballylumford to Ballymena. About 360 miles of line, including 18 miles for operation at 110 kV, were added in 1960.

Sales of domestic appliances by the Board were prejudiced by the reimposition of hire-purchase restrictions during 1960, and the public demand fell by nearly 11·5% compared with the previous year. The sales for the year totalled £276,245, with the emphasis on cookers and wash boilers.

20 MeV Van de Graaff Generator

THE largest grant so far made by the DSIR, of £750,932, is to be used to equip a new nuclear physics research centre at Oxford. The installation, consisting of two Van de Graaff generators, will be used to study the structure of atomic nucleii and will be the first of its type in the world.

The particle accelerator will consist of an 8-10 MeV vertical Van de Graaff generator which will be coupled to a 12 MeV horizontal Van de Graaff generator. The research team using the equipment will be led by Professor Denys Wilkinson, FRS. The 12 MeV generator is to be built by the High Voltage Engineering Corporation of America. The vertical 8-10 MeV generator is to be designed and built by the Electrostatic Generator Group of the National Institute for Research in Nuclear Science at Harwell.

Research Advantages

Use of Van de Graaff generators has two important advantages for nuclear work, they provide a precise control of the energy of emerging particles by voltage control, which is much better than that obtained with the cyclotron or the linear accelerator. They also give a steady current, enabling experiments to be carried out which would be impossible with the current pulses obtained from comparable machines. They also enable a great variety of ions to be accelerated, again, a feature which is not possible with resonant machines such as the cyclotron.

Study of Nucleii

The vertical machine will be designed for use either as a high intensity generator, or as a high energy injector in conjunction with the 12 MeV machine to give a combined energy of 20 MeV. Such a voltage is higher than the electrostatic barrier that surrounds the atomic nucleus and it will, for the first time, open up all elements for the precise study of such problems as the relationship between the shell model, in which the nucleus is pictured as a system of independently moving particles, and the collective model, in which the shape of the nucleus as a whole and its bulk rotation are the salient features. It will also make possible several important types of experiment on light elements which are not possible at the lower energy levels obtainable with existing machines.

The generator to be designed at Harwell will be for the first stage of a three stage accelerator. In this machine negative ions applied at its terminal will be accelerated through 8 million volts and then deflected into the horizontal plane for injection into the two subsequent stages which are combined in a single tandem generator. The vertical machine will be larger than similar machines so far built in the UK. Its pressure vessel will be 45 ft long, 13 ft diameter and will contain when fully charged, 4 tons of gas.

Negative H Ions

The hydrogen atom cannot only lose an electron to become a proton, it can also gain an electron to become a negative hydrogen ion. In the horizontal tandem machine, the incoming ions, with an energy of 8 MeV from the vertical machine, enter at one end and are sucked to the central terminal, which may be charged to 6 million volts. Here they pass through a thin foil, and in the process the negative hydrogen ions lose their electrons, emerging as positive protons. The protons are then repelled back to earth and emerge with an additional energy of 12 million volts.

new products and appliances

Mercury fluorescent lamps reduced

PRICES of the Philips range of mercury fluorescent lamps will be reduced as from June 15. Reductions range from 5s 6d for a 50 W lamp to £2 for 1 kW lamp. Mercury fluorescent lamps with internal reflectors have also been reduced, the new prices being: £4 15s for 250 W and £6 15s for 400 W, cuts of 5s and 15s, respectively. *Philips Electrical Ltd., Century Hse, Shaftesbury Ave, W.C.2.*

Transistorised electronic modulator

A DEVICE said to be considerably more reliable than its mechanical counterpart, the "SM 10" is a transistorised electronic modulator or d.c. "chopper." Using silicon transistors, the circuit is fully encapsulated and sealed inside an aluminium can. The unit is designed for low level d.c. chopping and is of the directly coupled type. It will operate from any 6 V sinusoidal or square wave power supply in the frequency range 40 c/s to 1,000 c/s and will switch chopping voltages in the range 1μV up to 250 mV. By using carefully selected and matched components, drift has been kept very low while a high stability is maintained over the working temperature range 0-55°C. *Telephone Manufacturing Co. Ltd., Martell Rd, W. Dulwich, S.E.21.*

Water-level control switch

A PRESSURE operated level switch to control water level in washing machines is being marketed by Teddington Autocontrols. There are at present two models, single level unit and multi-level control. The second of these enables the user to select the desired water level manually. The pressure level switch operates by displaced air pressure on a diaphragm and is connected through tubing to an air chamber coupled to the base of the wash tub. The change-over type of switch is used to allow sequential operation in automatic machines. Both controls are rated at 15 A and operate on 240 V a.c. *Teddington Autocontrols Ltd., Sunbury-on-Thames, Middx.*

More lamp price changes

STANDARD 25 W to 100 W tungsten filament lamps from Ekco—with the exception of 75 W—now come in the same sized bulbs and are all priced at 1s 8d including tax. This is a feature of new changes which became operative on Monday. Following increased popularity, 150 W and 200 W lamps have been reduced to 1s 10d and 2s 6½d, respectively. There is no alteration to prices of Ekco fluorescent tubes. *Ekco-Ensign Electric Ltd., Preston Hse, Essex St, Strand, W.C.2.*

Sub-miniature lamps

FOR specialised electronic applications a new sub-miniature filament lamp has recently been introduced. Rated at 6 V with a light output of 1 lumen, the lamp combines minute size with an exceptionally long life. This is said to exceed 10,000 hours at normal voltage and to increase to 60,000 hours if the lamp is de-rated to 5 V. Two versions of the lamp are available, one a capped version for which a corresponding lampholder has been designed. The other has wire-ended terminals and is suitable for incorporating with printed circuits. Overall dimensions for the lamps are 0·218 in. long by 0·139 in. dia. for the wire-ended version and 0·37 in. long by 0·182 in. dia. for the capped lamp. *Thorn Electrical Industries Ltd., Thorn Hse, Upper St. Martin's La, W.C.2.*

Kitchen fan is economical

LATEST unit by Fenton Byrn for extraction of kitchen fumes is in the form of an extractor fan incorporated in a canopy set over the cooker. A 4 in. by 4½ in. duct in the wall accommodates the exhaust outlet and a special 4 in. side outlet is available for canopies over cookers backing on to inside walls. The unit is rustproof and measures 17 in. high by 30 in. deep and 24 in. wide; it is supplied in standard white or cream stove enamel. The price is £26 14s 4d, and the fan is said to change the air in a 12 ft by 9 ft room 20 times an hour. *Fenton Byrn and Co. Ltd., West Molesey, Surrey.*

Miniature elapsed time indicator

TO give an accurate record of operating time of expensive and complicated electronic equipment, a miniature elapsed time indicator is now available in this country. Manufactured in the U.S.A., this is a synchronous motor driven device, only 0·68 in. long by 1·42 in. dia, which will register up to 1,000 hours elapsed time. Built for reliability, the unit has sapphire bearings with an enclosure filled with inert gas to prevent atmospheric corrosion. Motor windings are resin encapsulated.

Designed originally for missile system, the unit is suitable for 400 c/s supplies at 115 V or 26 V; alternatively a model for 28 V battery supplies is available. *Aeromaritime Ltd., 45 Ladbroke Sq, W.11.*

Protected plug-in relay

HAVING particular application in heavily polluted atmospheres are modified versions of the "MO1" and "M51" plug-in relays. These have now been fitted with protective covers of two types. One is simply for dust-laden air, the other gives protection against corro-

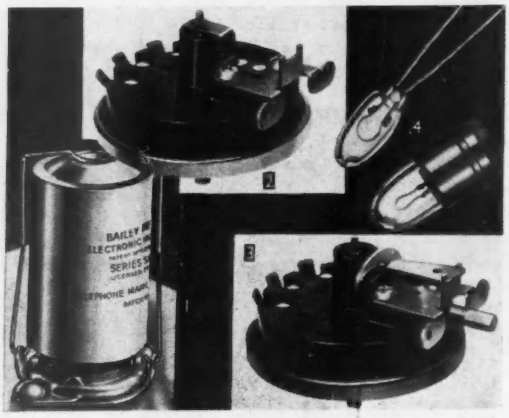


Fig. 1. Transistorised electronic modulator marketed by TMC. Figs. 2 and 3 show water-level control switches for washing machines by Teddington Autocontrols. Fig. 4. Thorn sub-miniature lamps for printed circuits

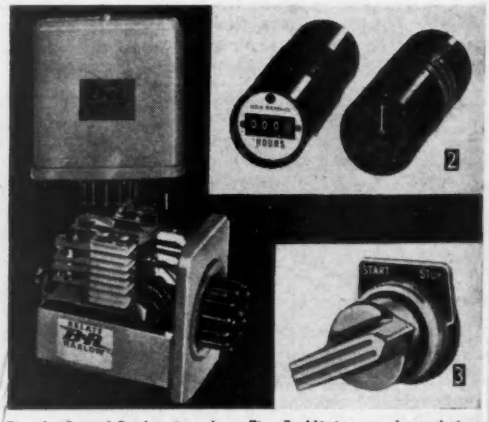


Fig. 1. B and R plug-in relay. Fig. 2. Miniature elapsed time indicator imported by Aeromaritime Ltd. Fig. 3. Oil-tight selector switch by Square D can be conveniently operated with gloved hand

sion in heavily polluted atmospheres such as produced by acid fumes. All relays are mounted on Octal type plugs with 8-14 pins depending on contact requirements. *B and R Relays Ltd., Temple Fields, Harlow, Essex.*

Mazda change lamp prices

ALTHOUGH increases have taken place in the price of lamps in the Mazda GLS range there are reductions in cost of 150 W and 200 W clear and pearl finish. Price of the clear or pearl 100 W domestic lamps remains unchanged. Other prices which took effect last Thursday are as follows:

	60 W	100 W	150 W	200 W
Single coil GLS				
Old price ...	1/5	1/8	2/3	3/6
New price ...	1/8	1/8	2/2	3/-
Netabulb				
Old price ...	1/8½	1/11½	2/10	—
New price ...	2/-	2/-	2/8	—
Plus Lamp	40 W	60 W	100 W	
Old price ...	1/5	1/5	1/8	—
New price ...	1/8	1/8	1/8	—

AEI Lamp and Lighting Co. Ltd., Melton, Rd, Leicester.

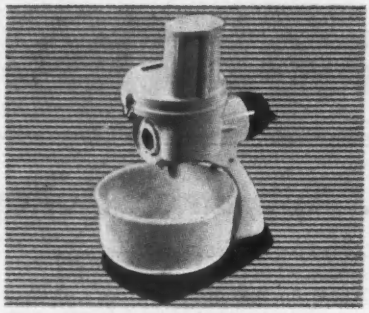
Feed water silica analyser

TO enable continuous and rapid monitoring of silica content in boiler feed water, development of a new type of colorimetric apparatus is announced. The apparatus automatically collects a measured sample of water from the feed and adds some molybdate together with a reducing solution. A blue colour develops which is compared photoelectrically with a sample of the original water. Concentration of silica can be detected in three ranges, 0-0·2, 0-2·5 and 0-30 p.p.m. Outputs from the photocells are fed to a mechanical chart recorder via a transistorised amplifier. *Electronic Instruments Ltd., Richmond, Surrey.*

Three-heat wash boiler

A COMPETITIVELY priced wash boiler by Gay-Day has triple-heat control and is available in two sizes, one 5 gal capacity and the other 7½ gal. The larger model is loaded to 2¼ kW and the smaller to 1·85 kW. Each boiler has two heating elements set in ceramic material beneath the tub. A circular perforated plate inside the boiler is said to promote boiling action. The tub is

Gay-Day's wash boiler comes in 5 gal and 7½ gal sizes with 1·85 kW and 2¼ kW loadings



Newest attachment for Sunbeam's mixer is a slicer and shredder shown in illustration. It has three separate blades and is finished in white plastics. Cost is £5 inc. tax

anodised aluminium on the interior and has an exterior finish of stove enamel. Prices are 8 gn for the large model and £6 19s 6d for the small boiler. *Gay-Day (Domestics) Ltd., Sales Divn., 47 Chorley St, Manchester 1.*

TRADE PUBLICATIONS

AVICA. — Eight-page leaflet describing gimbal type flexible joints and bellows assemblies. Avica Equipment Ltd., Mark Rd, Hemel Hempstead, Herts.

BRITISH DRIVER-HARRIS. — Four leaflets giving details of electrical alloys by British Driver-Harris Co. Ltd., Cheadle Heath, Stockport, Ches.

BULGIN.—Leaflet describing components for the electronics, radio and allied industries by A. F. Bulgin and Co. Ltd., By-pass Rd, Barking, Essex.

FLUIDRIVE.—Illustrated leaflet detailing applications of variable speed couplings. Fluidrive Eng. Co. Ltd., Worton Rd, Isleworth, Middx.

LINE EQUIPMENT.—Leaflet describing high voltage, powder-filled fuses, their applications and construction. Line Equipment Ltd., Bridgend, Glam.

TROUGHTON AND YOUNG. — Two leaflets detailing high-output lamps and fittings and "Tubalux" fluorescent lighting fittings. Troughton and Young (Lighting) Ltd., Wansdown Pl, Fulham Rd, S.W.6.

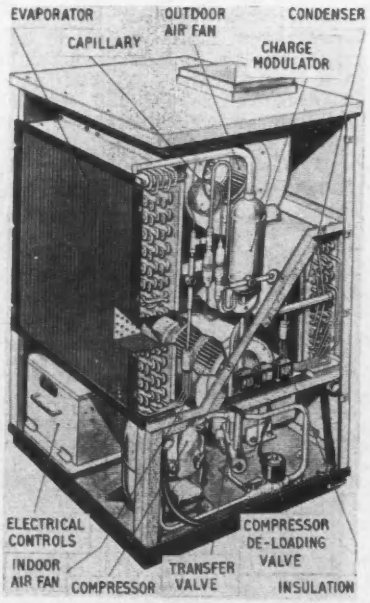
WYLEX.—Leaflet detailing "Sonex" cooker units for flush or surface mounting. Geo. H. Scholes and Co. Ltd., Wythenshawe, Manchester.

Heat pump for central heating

ENTERING a relatively little exploited field, Joseph Lucas announce the introduction of their "Climasol" range of heat pumps for space heating of domestic and commercial premises. Working on the "reversed cycle" heat engine principle, a heat pump functions by extracting heat from a low temperature source and delivering it to higher temperature surroundings. It offers one of the most efficient means of utilising electricity for heating purposes; thermal output from the device can be as much as three times the electrical power input.

Three versions make up the "Climasol" heat pump range. These are self-contained units, the first two, the "Gulfstream" and "Panama," being intended for domestic applications. The third, the "Tradewind," is for heating commercial premises. All three models are of the "air to air" type which extract low-grade heat from air outside the building and circulate warm air inside. Having a basic construction similar to a refrigerator, main parts of the heat pump consist of an "inside" and an "outside" heat exchanger connected through a throttling or "deloading" valve. Integral with this system is a 3 h.p. twin-cylinder hermetically sealed compressor which circulates Freon refrigerant. Atmospheric air is drawn through a duct by means of a ¼ h.p. fan and passed over the outside heat exchanger. This corresponds to the "evaporator" of a refrigerator, and extracts heat from the low temperature air. Freon vapour from the outside heat exchanger is drawn into the compressor, compressed to form a liquid, and passed on to the inside heat exchanger. Here its latent heat of vaporisation is transferred to warm the building by means of air circulated by a ¼ h.p. fan. Heat pump output for all three "Climasol" units is 31,500 B.Th.U./hr at an outside air temperature of 45°F. This is supplemented when required by heating elements incorporated in each unit.

For "Gulfstream" and "Panama" models, elements are rated at 3 kW; the "Tradewind" has a 6 kW element. Compressors for the domestic models have single-phase 230 V to 250 V motors, that of the commercial unit being 400 V to 440 V, three-phase. Gross electrical input for the domestic models at the rated output with heating elements switched on is 14·9 A. Feature of the "Panama" and "Tradewind" models is provision for reversing the flow of refrigerant to convert the heat pump for cooling applications during summer months. All three models incorporate automatic defrosting. *Joseph Lucas Ltd., Great King St, Birmingham 19.*



Cut-away view of Lucas heat pump unit

News of the Week

Change in H.M.V. Appliance Policy

New company will sell to retailers only

FROM the beginning of next month HMV household appliances will be distributed direct to retailers only. This contrasts with the present distribution of these goods to both wholesalers and retailers and is part of the emerging pattern of the EMI group's appliance trading since they took over Morphy-Richards Ltd. last September. The new arrangement does not affect the trading policy of Morphy-Richards Ltd., which will continue to operate as a separate entity and, in accordance with the terms of the takeover, will supply solely through wholesale channels.

Confirmation is not available, but it is believed that the EMI brand mark will in future be reserved for sound equipment and, in the meantime, EMI household appliances will be handled by HMV Domestic Appliances Ltd.

Recently, EMI formed a Domestic Appliances Division with the object of concentrating the sales and manufacture of all group's household appliances in the UK under the single direction of Mr W. Roxburgh, managing director of Morphy-Richards Ltd. The new move seems to be a change of emphasis, as HMV and Morphy-Richards will operate separately, but the idea of overall control by Mr Roxburgh has apparently been retained, for he is the only director on the HMV board so far and has been designated chairman.

Day-to-day control of HMV will be in the hands of Mr A. F. Burton, who has been appointed general manager and chief executive. Mr W. J. Hume-Humphreys will be sales manager and have under him five regional managers (for details of appointments see page 914). The new company already has headquarters at 363 Oxford St, W.1 (GROsvenor 7127) and its organisation and products will be explained to dealers by sales representatives who will begin a tour for this purpose on 12 June.

Radio and TV interests are unchanged.

Overtime rates in supply

CHANGES in the overtime pay for administrative and clerical staff in the electricity supply industry, operative from 1 June, have been agreed by the NJC. Among the alterations, the first hour on any day without payment has been reduced to the first half-hour, and plain time rate applies now to the first four hours, instead of to the first six hours of overtime in any week.

Separate provision has also been introduced for overtime on Sundays and public holidays. This stipulates plain time rates, plus half a day or a day off according to time worked.

Slower growth in industrial consumption

SLACK patches in industry during the early part of this year, such as shipbuilding, motor cars and appliances, are reflected in the Electricity Council's latest figures of unit sales. Industrial consumption in the three months to the end of March was only 3·3% higher than a year earlier, against an 8·2% rise in the preceding three months. As was expected after the mild winter, domestic consumption also showed a relatively small gain, with sales in the March quarter 16·8% higher, against 22·5% for the Dec. quarter of 1960.

Taking the year to 31 March as a whole, farm consumption showed the greatest rise. The figures in the accompanying table cover England and Wales only, and refer to units metered or billed during the period concerned.

	3 months ended		12 months ended	
	31 March 1960	% gain over last year	31 March 1960	% gain over last year
Domestic ...	10,634·2	+16·8	31,634·8	+17·6
Farm	559·2	+13·9	1,792·9	+18·4
Commercial ...	4,004·7	+10·2	11,981·3	+14·4
Combined dom./ commercial ...	509·6	+11·5	1,576·3	+14·2
Industrial ...	12,587·7	+ 3·3	44,708·8	+ 8·2
Public Lighting	236·6	+ 8·2	789·1	+ 8·2
Traction ...	419·1	+ 1·9	1,577·1	+ 1·8
Total (millions)	28,951·1	+ 9·3	96,060·3	+12·1

TAKE-OVER DEALS

B.I.C.C. buy Ulster firm

THE BICC group have acquired their first manufacturing plant in Northern Ireland by purchasing the share capital of Bessbrook Products Ltd., of Newry, County Down. Bessbrook were established in 1957 as manufacturers of enamelled wire, and BICC intend to continue these activities, making available their own long experience in this type of wire.

Bid for Superheater

INTERNATIONAL COMBUSTION (HOLDINGS) LTD. have bid to take over the Superheater Co. Ltd., offering seven 5s Ordinary IC shares for every ten Superheater Ordinary or "A" Ordinary 5s shares. The directors of Superheater Co recommend acceptance, and their largest shareholder, Combustion Engineering Inc. of New York (which owns 50·6% of Ordinary and 43·3% of "A" Ordinary) intends to accept. International Combustion recently renewed its agreement with Combustion Engineering Inc. covering technical advice for a further minimum period of ten years on terms providing for the payment of certain royalties and the allotment of 239,980 International Combustion Ordinary shares. Thus, if the offer becomes unconditional Combustion Engineering will hold over 10% of the increased Ordinary capital of International Combustion (Holdings).

Clydesdale Supply Talks

DISCUSSIONS are proceeding which it is hoped will result in an offer being made for the Ordinary capital of Clydesdale Supply Co., the directors of that Scottish radio, TV and furniture multiple retailer reveal. From preliminary trading figures, a substantial trading loss was made in the year ended 31 March.

Denis Ferranti Enter Polyphase Meter Market

DENIS FERRANTI METERS LTD. have acquired the electricity meter interests of Parkinson Cowan Measurement, thereby expanding their meter activities into the polyphase field. Since Denis Ferranti bought the Bangor factory of the former British Electric Meters Ltd. and began meter manufacture ten years ago, they have concentrated on single-phase models. Parkinson Cowan Measurement, on the other hand, have in recent years restricted their electric meter operations to polyphase types, based on their successful single disc design. This design was developed by Mr R. H. Wolfenden, who is now chief meter engineer with Denis Ferranti.

Mr A. Williams, director and group general manager of Denis Ferranti Meters, said the acquisition of Measurement's polyphase meter and maximum demand indicator business was a logical step. Denis Ferranti's business had expanded rapidly in recent years, both with the electricity boards and abroad, and the move would enable the company to consolidate their position.

Parkinson Cowan Measurement say they have hived off these meter interests in order to concentrate on hydraulics, industrial liquid metering and process control equipment. Their business in these fields is continually expanding, they add. Declining meter prices no doubt played a part in their decision.

FERRANTI MODERNISE METER DEPARTMENT

FERRANTI LTD., who already claim to be Britain's largest manufacturers of electricity meters, recently embarked on a £200,000 modernisation scheme which is expected to increase their capacity by 30%. The plan, which is due for completion by the end of this year, is designed to meet the "increasing demand" for their FM range of meters.

The principal feature will be the replacement of a semi-automatic machine arrangement by an automatic transfer line for machining the cast iron frame of the FM single-phase kWh meter.

Once the meter frame is clamped in the platen fixture in this new line, it will be passed through the entire sequence of machining operations without removal from the jigs, thus giving greater accuracy. Sixty-five platen fixtures will be accommodated simultaneously. The item of plant concerned will cost £84,000 and is called a 33-station automatic in-line linked transfer platen machine. It is being manufactured by James Archdale and Co., of Worcester.

Installation of this machine comprises the third phase of the programme, and will take place later in the year. The first phase is the reorganisation of the meter plating shop; and the second, the introduction of a wide range of new equipment and the improvement of plant layouts in other sections of the department. Both these phases are under way.

Significant in the present context of pressure on meter profit margins at home and abroad is the comment of Mr J. Prince, meter department manager and a director: "Much higher productivity will result. Ferranti claim to account for about half of UK's meter exports.

E.T.U. Defence Continues

REJECTION of allegations of irregularities in the union elections continued when the action by Mr J. T. Byrne and Mr F. Chapple against 14 officials of the Electrical Trades Union was continued in the Queen's Bench last week. When questioned about an article he wrote for the *Daily Worker* after the Cannon *v.* Fraser election in 1957, replying to newspaper charges of ballot-rigging, Mr G. Scott agreed that he had written that if all the branch returns had been accepted, Mr Fraser would still have been elected. Counsel for the plaintiffs, Mr G. Gardiner, Q.C., said the truth was that if all the returns had been accepted, Mr Cannon would have had a majority of 34. Mr Scott agreed that was so on the figures counsel had given him. If he had made an error in checking the returns of disqualified branches it was a genuine error and he accepted full responsibility. Mr Justice Wynn then said: "If you choose to defend your union and its leaders against what you honestly thought was a lying campaign of distortion, it is fatuous not to be sure of your facts before you make statements in the public Press."

On Friday, Mr N. Swift, managing director of the Union's printers, agreed that such errors as had occurred in the dispatch of ballot papers could be due to mistakes made in his works. The papers had to be dispatched in a hurry and he employed about 20 women as casual labour.

Earlier, various branch officials had denied that increases in their postal votes were the result of "fiddling."

In the action, Mr Byrne and Mr Chapple maintain that Mr Haxell's election as general secretary is void, and seek damages for conspiracy. The hearing continues.

Superheat condensate uncertainty

THAT economic advantages would stem from a clearer understanding of heat-transfer rates when condensing superheated steam was the main conclusion reached at a two-day conference held recently at the National Engineering Laboratory. The conference was attended by over 100 delegates and it became clear during discussion of the six papers presented that uncertainty about heat transfer rates with superheat was apparent both from literature and from the experiences of delegates. Some observers had found that superheat decreased the rate of heat transfer, while others reported that it had no effect.

Some firms fit desuperheaters either because they believed they improved the heat-transfer characteristics of the steam or to avoid thermal stresses in pipework. With saturated or slightly wet steam, it was suggested, temperature was easily changed by adjusting steam pressure.

Details of publication of the conference proceedings are available from The Director, National Engineering Laboratory, East Kilbride, Glasgow.

NFEA Agreement Before RP Court

AGREEMENTS operated by the NFEA have been under consideration by the Registrar of Restrictive Trading Practices for some time. The list for next Monday's hearings before the Restrictive Practices Court includes an application concerning NFEA agreements, and is likely to involve recognition that the Association has abandoned recommendations for margins to be added to cost in charging for some types of work.

New 'Fridge coming

THE first of the major new products to be launched by Birmingham Sound Reproducers Ltd. will be a 4 cu ft compressor type refrigerator, Dr D. M. McDonald, the chairman, revealed last Thursday. It is hoped to be in production at the beginning of next year at the new plant at Stourbridge, which he claims will be one of the most up to date in the world. Selling price of the refrigerator is put at around 39 gn. We reported on 8 Dec. last that BSR had acquired the name Monarch Electric as the title of a new subsidiary to produce domestic electrical appliances. The company were then proposing to utilise their Londonderry works for the purpose.

THAT TELEPHONE SHORTAGE

THE apparent growing inability of the Post Office, within limits still set by Treasury allocation of capital, to meet the mounting demand for telephone service was referred to by Mr S. C. Rosser, president of the Post Office Engineering Union, at the opening of their annual conference at Scarborough on Monday. In two years the order list had grown by 20%, more than a million residential subscribers were still compulsorily sharing, and the Post Office admitted that 200,000 of these were unhappy at sharing. There was no prospect of the Post Office giving everyone a choice of private telephone and there was an ever-increasing potential market almost untapped. Yet the rate of growth was below that of nearly all the countries of Europe and the USA.

Director-General of the Mexican Federal Electricity Commission, Sr Ing Don Manuel Moreno Torres, second from left, with Mr E. Gallizia, assistant chief engineer (on the left), looking at a "Compak" rectifier during a visit to the GEC Witton Works. Also seen are Dr W. G. Thompson (manager, Rectifier and Electronics Div.), Mr Soto (Interpreter) and Mr K. W. Birks (works manager, Rectifier and Electronics Div.)

The new showroom of the South Wales Electricity Board at Market Street, Bridgend. Above it are offices on three floors. Electric floor-warming is installed throughout

NEW SHOWROOMS AT BRIDGEND

IN Market St, Bridgend, the South Wales Electricity Board have just opened new showrooms and offices which have electric floor-warming throughout. Outside heating is provided by 2 kW Thermodare overhead heaters mounted underneath the canopies above the windows.

A three-storey building, the showrooms occupy the ground floor, the first and second floors being offices for clerical departments, with the top floor allocated to engineers and the drawing office.

The showroom lighting, with AEI equipment, includes an Isora ceiling, but GEC 101 range lighting units with a variety of diffusers are utilised in the offices. Floor-warming by the Panelec solid embedded system has a loading of 22 kW/floor, controlled by a Maclaren thermo-time regulator and with each 2 kW circuit controlled by an ECC miniature circuit-breaker.

ELECTRONIC COMPONENTS OUTPUT

PRODUCTION in the radio and electronic components industry now runs at 2,650 million items a year, worth £130 million, and exports last year were worth more than £13¼ million—36½% above the 1959 figure. These figures were given by Mr A. F. Bulgin in opening the annual Radio and Electronic Component Show last week.

Although the figures may not be strictly comparable, a Census of Production report covering radio and other electronic apparatus, published by HM Stationery Office on Friday last, shows that, in 1958, total sales of goods produced amounted to £241,138,000, compared with £162,393,000 in 1954. To these figures, valves and c.r.t's worth £32,778,000 and £18,846,000, respectively, must be added.

New Gatwick Building

A NEW TEE Building at Gatwick Airport, which will be used as a main repair depot for telecommunication systems for airports in Britain, was officially opened on Tuesday. Already claiming radar aids among the most advanced in the world, Gatwick is also being provided with a new ACR building for development of radar control systems.

OFFICIAL PUBLICATIONS

Iraq: Report of Trade Mission to. HMSO. 2s (see page 928).

Report on Census of Production, 1958. Part 59. Radio and Electronic Apparatus. HMSO. 2s 6d (see this page).

National Coal Board. Report for 1960. HMSO. Vol. 1. Report, 4s; Vol. II, accounts and statistics, 9s (see page 912).

Review of Data on Burnout Heat Flux for Steam-Water Mixtures in uniformly heated channels, by A. F. Pexton, UKAEA Report. HMSO. 4s.

BS G177. Nyvin type electrical cables for aircraft. 15s.

Electricity Supply Industry in Europe. 11th Enquiry. OEEC Report. HMSO. 9s.

Eire considers suppressors

WITH television due to start in Dublin by the end of this year, the Dail is likely to introduce legislation compelling the fitting of suppressors to vacuum cleaners, hair dryers and other apparatus liable to cause interference. The Minister of Posts and Telegraphs has appointed a committee of Post Office officials and specialists from industry to advise him on possible legislation.

Among the members are Messrs P. G. Callaly, Electrical Industries' Federation of Ireland; A. K. Jackson, ECA; W. B. Peat, Wireless Dealers' Association; and S. Tinney, Electricity Supply Board. Existing UK regulations requiring suppressors to be incorporated at the time goods are manufactured will no doubt enter into their deliberations.

NEW B.I.S.R.A. RESEARCH SECTION

THE British Iron and Steel Research Association has created a new section in its Plant Engineering and Energy Division to centralise the Association's research into control engineering. When the Plant Engineering and Energy Division was formed, an Electrical Engineering Section was included to carry out research into the electrical equipment used in steelworks. During the last few years, and with the increasing interest being shown in automation in the iron and steel industry, the research of the section has tended more and more towards the electrical engineering aspects of automatic control systems—their design, construction and application to steelworks plant. Some work on hydraulic control systems has also been carried out in another section of the Division. The basic theory of control applies to both, and the one selected depends upon the specific requirements.

In view of the advantages to be gained in bringing all the work in the Division on control engineering within the province of one section, the Electrical Engineering Section has been replaced by a new Control Engineering Section.

The change of name is a recognition of the gradual change of emphasis in this field of work. Head of the new section is Mr J. P. Clyne, who recently joined BISRA from the Sperry Gyroscope Co.

Power Failure in the City

A MECHANICAL fault in one of two transformers at the CEGB's substation at Bankside caused a disconnection in parts of the City of London and Southwark just before midday last Thursday. By coincidence, the other transformer was undergoing maintenance at the time, but only 5,500 consumers were affected and supplies were fully restored by 12.30 p.m.

The Electrical Industry participated to the full in last week's Commonwealth Technical Training Week in which the Duke of Edinburgh played an important role. Among the many functions organised to stimulate interest in Wales was a two-mile long procession of marching apprentices and mobile pageant of industry, reviewed by the Duke last Friday. This was followed by a garden party in the grounds of Dyffryn House, where our picture shows the Duke exchanging comments with Mr A. J. Nicholas, (of South Wales Switchgear) Chairman of the Welsh National Committee

CABLE UNDER MENAI STRAITS SUGGESTED AT INQUIRY

OPPONENTS of the proposed Wylfa nuclear power station, Anglesey, were criticised by Mr C. Hughes, MP for Anglesey, at the public inquiry into the proposals, held at Amlwch, last week. Emphasising that Anglesey existed primarily for the people of Anglesey, he said they welcomed visitors, but there were times when he felt that some of those people showed more concern with its scenery, fauna and flora than with its people's well-being. "We natives of the island are as deeply conscious of the need to preserve its beauty as they, and also to carefully consider how the station's power lines are taken over the Straits at one of the beauty spots of Europe," he said. But the island needed a fairly large industry to permanently employ its school leavers, rising from 663 this year to 902 in 1963.

That argument was also put forward by Mr J. Davies, Clerk to the Anglesey County Council, who supported the project as a major step towards solving those difficulties. But that Council, while agreeing in general with the proposed routing of the transmission lines, could not accept a proposed o.h. route near Britannia Bridge across the Menai Straits. He hoped the Minister would see to it that the crossing would be by underwater cables.

Earlier on, Mr H. W. Grimmitt, the presiding inspector, had said that the inquiry would be confined to the siting of the station and its line across Anglesey. There would be ample time—perhaps another inquiry—to discuss routing of the two lines on the mainland.

The sole objectors to the entire scheme, on amenity grounds, were the self-styled North Wales Hydro-Electric Protection Society and a number of residents.

Putting forward the plan for the CEGB, Mr S. B. R. Cooke explained that five sites were investigated in Anglesey before Wylfa Head was chosen. The station would employ between 400 and 500 permanent staff. About one-fifth of the station's output would be absorbed in Anglesey and N. Wales, and the remainder passed on to the Manchester grid control area.

It was proposed to erect a 400 kV single overhead line from the station to Bangor on the mainland. Anglesey County Council had asked that submarine cables be used across the Menai Straits, but it would cost £600,000 more to lay the cable in an underwater pipe, and £795,000 more in a tunnel under the Straits.

To carry it through the Britannia Bridge would not be possible without altering the shape of the bridge, the inspectors were told. Chief Wayleave Officer to the CEGB, Mr R. E. Wacher, agreed that the Fine Arts Commission had expressed views opposing the plan for an overhead cable across the Straits.

Mrs C. Williams-Ellis, branch chairman, CPRW, also opposed the inquiry's "isolated consideration of the Anglesey line" without considering its effect on the mainland routes and the resulting future possibility of pumped-storage schemes in Caernarvonshire. The Lord Lieutenant of Caernarvonshire, Sir Michael Duff, also objected to the lines which, it was said, would be visible from his home, Vaynol Hall.

The inquiry ended on Friday, and the inspectors are visiting the areas concerned.

NUCLEAR ENERGY CONFERENCE

OVER 100 scientists from 15 countries are attending the nuclear power conference organised by the CEGB, which opened at Berkeley, Glos, last week, on the day following the official opening of the nuclear laboratories there. In the opening session papers were presented by Mr G. H. Kinchin and Dr W. M. Lomer, of the UKAEA, and by Prof F. Seitz, of the University of Illinois.

Opening the conference, Sir Christopher Hinton, chairman of the CEGB pointed out that in the early days of nuclear energy an exchange of thought was impossible, because work was then done within the field of the defence industry. A great step forward was taken at the first Geneva conference, which paved the way towards an extensive exchange of information on an international basis. Since then, nuclear power had established its position in the electricity supply industry, which had for many years enjoyed international freemasonry for the interchange of research information.

Appliance Sales Rise

SALES by radio and electrical shops picked up slightly in April, but were still 7% below the level of April, 1960, the BoT reports. Credit sales of these goods were about 3% higher in April than in March, but most of the £5 million rise in the nation's hire purchase debt, now £939 million, was on car sales.

March's production index shows that engineering and electrical goods moving ahead 3% on the previous month, while overall production was steady.

Power Industries Co-operate on Remote Control

A BASIC specification of equipment for the remote control of plant in power networks, coal mines and gas works has been published by the Joint Radio Committee of the Nationalised Fuel and Power Industries. The three industries, which have been co-operating for years on radio communication problems, have put their heads together on remote indication and control over both wire and radio links as well, because their requirements have much in common in this sphere also.

The specification provides information on the minimum facilities required and guidance on the techniques preferred. For example, the use of cold cathode tubes, transistors and magnetic cores is advocated rather than electro-magnetic relays and hot cathode valves. But it avoids laying down rigidly the manner in which any technique should be used.

The specification, it is hoped, will rationalise the production of suitable equipment and reduce design work. Plessey and Pye have already successfully demonstrated systems specifically designed to meet the requirements of the basic specification. It is named the Basic Specification for Electronic Telecontrol Equipment. Copies may be obtained from Mr G. D. Turton, secretary of the Joint Radio Committee, c/o CEGB, Bankside Hse, Sumner St, S.E.1.

Well-lit Drawing Office

Specially designed twin-lamp fluorescent fittings with Paragrid-tile diffusers and "Perspex" sides, mounted in continuous runs on the ceiling, provide an average of 75 lumens/sq ft in the drawing office of Power Gas Corporation Ltd. Each fitting is individually controlled by a pull switch mounted on the metal spacer separating each fitting. Harris and Sheldon Electrical Ltd. made the fittings, the contractors being Phoenix Electrical Ltd.

B.E.A.M.A. Export Conference Programme

BEAMA have announced the programme for their Golden Jubilee Export Conference which will be held at the Connaught Rooms, London, on 5 Oct. and 6 Oct. Assembling at 10.45 a.m. on the first day, the conference will hear an opening address by Mr A. M. Browne, president of BEAMA, followed by Mr F. H. S. Brown, deputy chairman CEGB, on engineering achievements in this country and their effects on exports. Mr R. Maudling, President BoT, will deliver a speech at the conference luncheon. In the afternoon Sir William McFadzean will speak on exporting to Europe, and Mr W. J. M. Longmore will deal with the western hemisphere.

On the second day the delegates will split into discussion groups dealing with five specialised aspects: finance, market research, standards and designs, the changing pattern of overseas trade, and publicity. These discussions will begin at 10 a.m. and the conference will end with a buffet lunch.

DISCOUNT FIGHT

"ACTION within the trade" has been threatened by Hertford Chamber of Commerce against Mr C. Cooper, a small electrical retailer, unless he stops giving discount to trade union members. Mr Cooper says at least half a dozen other traders in the town are giving the discount and that he will fight the Chamber. He had been picked on because he advertised the discount, he said.

Numerous electrical works were visited by members of the IEE, together with their ladies, during the Summer Meeting in London last week. Here, the party is touring the works of Enfield-Standard Power Cables Ltd. Shown in the front row, l. to r., are Mrs J. Sticher, Mr J. Sticher (Detroit Edison Co.), Sir Hamish MacLaren (president), and the Earl of Verulam

DEFECTIVE LEAD—M.E.B. FINED £25

FOR having an unprotected extension lead to a power plug, the Midlands Electricity Board was fined £25, plus 6s costs, at Willenhall Stipendiary Court last Thursday. Commenting on the matter, Mr F. G. W. Denton, HM Inspector of Factories, said "it seemed incredible that a body like the MEB should produce and supply equipment for employees which was sub-standard to say the least." He explained that the Board were engaged on building operations for a showroom in High St, Wednesfield, last December, when an employee and an apprentice went to install electrical equipment.

In removing brickwork for some new wiring, they found part of the chasing was defective and used a portable electric tool to hack it out. On completing the job the apprentice was told to pack up the equipment and when he withdrew the plug, received a shock and burn on his hand. He fell, struck his head and caused severe lacerations to the scalp which necessitated skin grafting.

It was stated that the equipment was made up at the Board's Tipton workshops and had been used several times. But it was wired up wrongly, the plug remaining live.

Counsel for the Board, Mr. W. B. Brooks, said the Board regretted the incident and had taken every special precaution for the safety of employees.

Human nature being what it was, even in the best organisation it had a worker who made up a tool without authority or the knowledge of his superiors, which had happened in this case.

Promising Market in Iraq

OIL-RICH Iraq is spending nearly £100 million a year on development under its interim Economic Plan covering 1959-63. This is reported by the trade mission which visited the country in February, headed by Mr H. G. Nelson, managing director of English Electric. With an oil income of around £90 million a year, Iraq has the ability to pay and British goods are held in high regard.

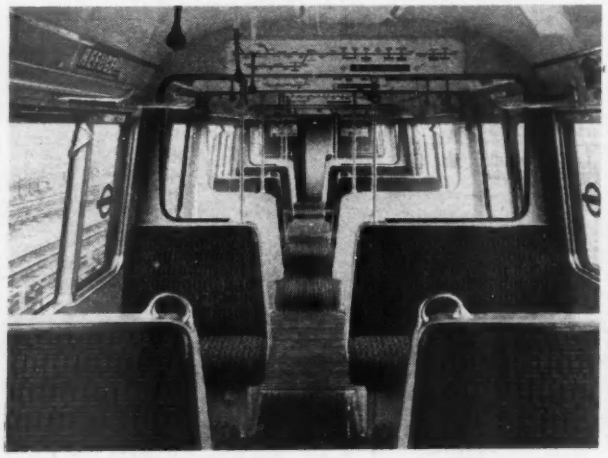
But competition is growing more intense not only from the US, Germany and Japan, but also from Soviet Bloc countries. Russia is currently providing Iraq with 13 factories as well as other forms of assistance, and will no doubt obtain a good deal of follow-on business as a result. The Germans hope to obtain a similar advantage from their German Technical Institute near Baghdad, which, paradoxically, teaches in English.

Britain stands at the crossroads, the report says. She can either increase her share of the market, by greater selling effort, or fall back. The UK share has slipped from £34·4 million in 1957 to £28·9 million in 1960, but Britain is still the largest supplier. About a tenth of these goods are electrical.

Iraq will require 30 new diesel-electric locomotives by the end of 1963, 25 of 1,650 h.p. and five 750 h.p., for the Baghdad-Basra railway which is being converted to metre-gauge. It is significant that Russia provided technical experts for this conversion, and in July last year made an additional loan of 180 million roubles (£16 million) for equipment. The line will eventually be electrified.

NEW MET. LINE TRAINS

THE introduction of new underground trains, commencing 12 June, on London Transport's Metropolitan line promises a 25% increase in seating capacity for passengers travelling to Uxbridge, Watford and other outlying stations; in addition there will be a big increase in standing space for carrying rush-hour crowds. The trains are of the lightweight type with aluminium bodies, double sliding doors and rubber suspension. Motor bogies each have twin motors giving good acceleration; they are of a type already tried out on recent Central line stock. Features of note in the car interiors are transverse facing seats, parcel racks and extensive use of aluminium for fitments.



Interior view of new Metropolitan line underground stock, showing the transverse seating arrangements with accommodation for up to 56 passengers. A novel feature, shown in the picture, is glass screened vestibules for standing passengers. The trains have fluorescent lighting, and there are racks for parcels

E.E. IN AERO PARTNERSHIP WITH ROLLS-ROYCE

HAVING merged the bulk of their aviation interests into British Aircraft Corporation last year, English Electric have now decided to sell 50% of the aero engine business of their D. Napier and Son subsidiary to Rolls-Royce. The Eland turbo-prop and Gazelle free-turbine engines constitute the main Napier aero engine activities at present. A new company, Napier Aero Engines Ltd., is being formed with Rolls-Royce to handle these and future developments. D. Napier and Son will retain its engineering business in other fields.

COIL SPRING RESEARCH

IT is just over a year since the Coil Spring Federation Research Organisation opened laboratories at Sheffield, and about the same time set up an industrial liaison scheme. Success with both ventures was reported to the Federation's annual conference recently. One of the research projects undertaken concerns the difficulty of coiling springs of high index made from phosphor bronze wire. When the curvature required by the wire is such that the material is not strained far beyond its elastic limit, a considerable variation in spring dimensions can occur. A co-operative effort with the BNFMRA and a wire manufacturer is aimed at solving this problem. Another project resulting from CSFRO initiative is development by a machine tool manufacturer of an automatic spring-coiling machine, which could help production.

The CSFRO have now applied to the Board of Trade to register the title of the Spring Manufacturers' Research Association without the addition of the word "Limited."

Sayings OF THE WEEK

"We don't hesitate to use electricity if it helps us to provide a better service." . . . MR N. HUDSON, commercial manager, North Eastern Gas Board, opening a heating display.

"No retailer can sell electrical current-consuming devices at less than manufacturers' list price and at the same time . . . give adequate technical service at the time of the sale and thereafter." . . . MR C. R. WATERHOUSE, ECA president, speaking at the Association's annual conference.

"Only one worker in 22 in industry as a whole is receiving any form of technical education, whereas in the Post Office Engineering Department one person in seven is undertaking some form of technical study." . . . MR S. C. ROSSER, president, PO Engineering Union, at the annual conference.

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Tuesday, June 6

	£ per ton	Weekly change £
COPPER, standard class A (settlement) ...	238½	−5½
" (3 months)	241½	−4½
LEAD, refined pig, 99·97% purity (cash)	64½	−½
" (3 months)	66	−½
TIN, refined, min. 99·75% purity (settlement)	878	+5
(3 months)	881	+3
ALUMINIUM, ingots 99·99-99·5% ...	186	—
" wire bars (4×4×54")	193½	—
BRASS Strip 63/37	207½	−2½
SILVER (Troy oz)	79¾d	—
ZINC, virgin, min. 98% purity (cash)	81½	−1
" (3 months)	82	−½
RUBBER, per lb. No. 1, RSS, spot	25½d	−1d
c.i.f. basis, ports, August ...	25d	−¼d
ARMOURING: Galv. Steel Wire (0·104 in.) ...	67½	—
Mild Steel Tape (0·04 in.) ...	53*	—
NICKEL (home)	600	—
MERCURY (76 lb flask)	67	—
AMERICAN PRICES: Copper, electrolytic (per lb) ...	31c	—
Lead, (New York)	11c	—

* *Tape Price, now an average, includes varnishing*

LARGE CONTRACTS AWARDED

A £1½ MILLION order for the first switchgear for the 400 kV Supergrid has been placed with the English Electric Co. by the CEGB. It will cover 13 35,000 MVA air-blast circuit-breakers, eight of which will be rated at 4,000 A and five at 2,000 A, together with power operated isolators and other apparatus to form a duplicate busbar switching station.

AN order worth £10,000, for more than 600 remote indication and control equipment systems for Russia, has been received by Newman Electronics, division of Newman Industries Ltd.

PIRELLI-GENERAL Cable Works Ltd. have been awarded a £182,500 contract by the South Eastern Electricity Board for the manufacture, supply and installation of cables and ancillary apparatus at Chessington grid—Esher and Cobham. The contract comprises 23,300 yd of three core 33 kV corrugated aluminium sheathed oil-filled cable having extruded p.v.c. outer protection, and some 8,300 yd of p.v.c. insulated pilot and telephone cables. Installation work is to commence in October and completed next March.

A CONTRACT for electrical equipment, valued at over £250,000, for a Soviet tissue-paper making plant, has been placed with Associated Electrical Industries Ltd. As sub-contractor to the Charles Walmsley (Bury) group, they will supply the motors and control gear.

SUDAN Railways have placed a repeat order for ten diesel locomotives with the English Electric Co. Ltd.

THE English Electric Co. Ltd. are to supply diesel-electric propulsion machinery, valued at over £200,000, for a hydrographic survey vessel for the Royal Australian Navy. Three 1,330 kW main generators are to be arranged in a series-sandwich with two 2,500 s.h.p., 250 r.p.m., 900 V propulsion motors which can be controlled on the modified Ward-Leonard principle from either the bridge or the engine room.

RICHARDSONS, WESTGARTH have received a £300,000 order for the condensing plant to be used with a 300 MW turbo-generator at West Thurrock.

Climbing in the Caucasus

A SUCCESSION of early morning phone calls from Moscow brought Mrs P. Dunsheath the news that her climbing excursion to the Caucasus in 1957 had been approved. At the Batti Wallahs' monthly luncheon last week, Mrs Dunsheath, only the third lady to be asked to address this electro-nautical body, described her climb of the highest mountain in Europe and her subsequent visit to a remote town in the republic of Georgia. Mrs Dunsheath was presented with a bouquet, and thanked for her address by Mr J. S. A. Bunting. The next meeting of the Society will be held at the Connaught Rooms on 28 June.

News in Brief

A new service centre at Goldthorpe has been opened by the Yorkshire Electricity Board.

The annual presentation of awards and indentures to engineering apprentices at English Electric, Rugby, took place at Dunchurch Lodge last Saturday.

Aerialite Ltd. have supplied a communal TV aerial system for 999 dwellings in one of the largest blocks of flats to be erected in the UK, recently completed for Sheffield Corporation.

Owing to a recession in the TV and radio industry, AEI Ltd. have decided to pay off over 300 employees at the Sunderland factory.

Cable for the turf heating installation at Harringay stadium (ELECTRICAL TIMES, 1 June, page 889) was manufactured by Pirelli-General Cable Works Ltd.

For the Stour Valley Vehicles showroom, referred to on 18 May, page 811, Newey and Eyre were not the contractors. They supplied electrical equipment to a local electrical contractor.

H. Frost and Co. Ltd. are holding a series of exhibitions of their new heaters, starting in Birmingham on 21 June.

OVERSEAS NEWS

from our correspondents abroad

CANADA

Cables Across St. Lawrence

The underwater power cables across the St. Lawrence River to the Gaspe peninsular, laid for the Quebec Hydro Commission, had never functioned properly since they were first laid in 1954 at a cost of $12 million, the Minister for Natural Resources, Mr R. Levesque, told the provincial legislature last month. He said that a breakage in the cables cost about $1 million every time. A new overhead line is now being erected to ensure power supplies to the area. These four submarine cables across the bed of the St. Lawrence, laid by HMTS *Monarch*, is the subject of a legal action, to which we referred on 4 Aug., 1960, in which Quebec Hydro and the Canada Wire and Cable Co. are claiming $885,591 damages from Lloyd's of London and the Institute of London Underwriters. The Canadian concerns are endeavouring to recover the cost of damage incurred during the laying of the cables when a barge cut a cable and other damage was caused by bad weather.

Columbia Impasse

Once again, plans for the Columbia River power development have become bogged down, this time in a dispute between the Canadian Federal Government and British Columbia. Having signed the treaty development with the US, the former offered to loan British Columbia $172 million covering half the cost of the three storage dams to be built in the province. Shunning the offer, British Columbia has given the federal government two choices—to undertake the whole $458 million project entirely by the federal government, or British Columbia would undertake the project if Ottawa guaranteed that the resultant power would cost not more than 4·25 mills/unit. With neither side yielding an inch an impasse has arisen, although there are reports from Vancouver that British Columbia might be prepared to give the Peace River scheme the go-ahead. The cost factor is an important one, and is now being studied by the BC Energy Board, whose report is expected any day now.

Save Those Posts!

Local agitation against proposals to remove old style cast-iron street lamp posts in modernising of street lighting is not confined to Britain. A similar situation has arisen in Victoria on Vancouver Island, where cluster light fittings, complete with flower baskets, have been in use since the days of horse carriages. It was considered that they no longer provide good illumination for present-day street traffic, and the City Council, acting on the recommendation of the city electrical engineer, agreed to scrap most of the 740 clusters and replace them with modern lighting standards. But local reaction to the decision was strong and, bowing to the pressure, the council have rescinded their earlier decision, and are to retain all the cluster lights, spending $58,000 on their rehabilitation!

BRAZIL

Rapid Expansion

Total units sold by the undertakings of the Brazilian Traction Light Co. during 1960 increased by 11% to 9,362 million units. Another indication of the growth taking place is the increase of nearly 100,000 new consumers, raising that total to 1,766,000 served by the companies. The largest increase occurred on the Sao Paulo system, where units sold rose by 12·9% and 72,247 new consumers were connected. Two new 125 MW steam generating sets were commissioned early last year at the Piratininga plant near the city of Sao Paulo. At the Cubatao underground plant the fifth 65 MW set has been put into operation, and the sixth unit, to complete the station, is scheduled for commissioning this year. No new generating capacity was added to the Rio system, but construction work has been resumed on the Poute Coberta project which should be completed this year. That station should enable the company substantially to meet the power demand in the Rio area up to 1963. It is suggested that a steam power station should be built for the Rio system, and the authorities have been notified of this. But until there is a major improvement in the finances of the Rio Light Co., that subsidiary is not likely to undertake such a project.

NORWAY

H.E. Scheme

The construction of a hydro-electric plant on the Pasvik River is envisaged under a Bill just submitted to the Norwegian Storting. The plan calls for leasing the state-owned Skogfoss waterfall to A/S Sydvaranger, Kirkenes, Norway's largest iron ore mining company. Development and construction of the proposed Skogfoss power plant is to be undertaken by A/S Sydvaranger and the Varanger Power Co. The Pasvik River, which forms part of the 122-mile frontier to the USSR was the subject of an agreement on power development entered into by Norway and Russia some four years ago. Under that arrangement, Norway was given the biggest waterfall, Skogfoss, where a 64 MW power station was proposed, and Melkefoss, a few miles down river.

SPAIN

Coal Plans

A recent decree has authorised the establishment in Spain of two companies, which will be majority-owned by the Instituto Nacional de Industria. One company will concern itself with the exploitation of the coal reserves at Peñarroya. The other, using fuel supplied by the first enterprise, will produce electric energy with two generating sets of 60,000 kW total capacity. The companies are being granted the qualification of "national interest" and will benefit from exemptions and reductions in import and other taxes.

NIGERIA

Improved Outlook

Giant strides towards greater self-financing are now being made by the Electricity Corporation of Nigeria, whose financial situation was far from happy a few years ago. From a revenue of £4·6 million from operations in the year ended 30 June, 1960, a net surplus of £442,095 resulted (compared with £427,177 in the previous year) and it is confidently expected that the surplus for the current year will be higher still. In fact, the outlook for the Corporation is distinctly rosy, with good progress in adding new generating plant, and confirmation from the consultants, Merz and McLellan, that the present rate of load development is likely to continue at least for a year or two. And this does not take account of several large industrial developments which are known to be in hand.

In the year to 30 June last, units sold by the Corporation increased by 18% to nearly 287 million, of which 42% went to commercial and industrial users, a similar amount to residential consumers, 1·8% for street lighting and the remainder to consumers on bulk supply, general purpose and other tariffs.

Some 35,375 kW of additional generating plant was added during the year and a further 44,835 kW is being installed. An indication of the rapid expansion taking place in Nigeria is that in the nine years since the Corporation took over, both installed generating capacity and aggregate maximum demand have increased about sevenfold.

The first phase of the Corporation's New Towns Development programme has been launched, and by October next supplies will be given to 28 such towns, involving the erection of about 300 miles of 33 kV transmission in addition to net-

work in the towns themselves. Meanwhile, surveys are being carried out for a number of towns to be included in the second stage of development. Among the new transmission lines soon to be undertaken is a 132 kV line to link Kaduna, Zario and Kano, and a 33 kV line from Calabar to Aba. On the generation side, good progress has been made on the Afam power station, which is to have two 10 MW gas turbines, and site investigations continue for the proposed Niger and Kaduna hydro-electric scheme.

CONGO

Power for Copper Mines

Some indication of the important role played by the Rhodesia Congo Border Power Corporation during the political upheaval in that area nearly a year ago, is given in the Corporation's operating report for 1960. Reversing the normal arrangement, the Corporation exported 1,037,500 units to Katanga during the July crisis, but in the remainder of the year over 522 million units were sent from Katanga to the Corporation. In addition, the latter took over 761 million units from the Kariba hydro-electric project, plus 8·2 million units from Ndola. It is stated that the incidence of outages on the 330 kV interconnector with Kariba was somewhat higher than had been anticipated and the Federal Power Board is investigating the matter. The Corporation has undertaken to receive 880 million units from Kariba during the year to 30 June, 1961, and 1,042 million in the following 12 months. With these arrangements, operation of the mining companies' thermal plants is restricted to the availability of surplus waste steam. The emergency load shedding arrangements designed earlier to avoid a system collapse in the event of loss of the Katanga supply, were modified during the year to cover the new conditions created by interconnection with the Federal Power Board's system. Although on 12 occasions these arrangements proved effective in preserving the alternative supply, on three occasions loss of Kariba supplies was followed by loss of Katanga on overload, resulting in a total system shutdown apart from local thermal generation. On each occasion, supply from Katanga was re-established within 12 min, that from Kariba taking up to an hour in the worst case.

INDIA

Less Soviet Aid?

Russia is reconsidering earlier proposals for collaboration in several of India's industrial projects, according to reports. It is understood that Russian experts now want to reduce substantially the production programme of the heavy electrical works, which is included in the list of projects to be financed from Soviet aid in the earlier stages of India's third Five-Year Plan. Russia is also suggesting that India should give up altogether the proposed plant for the manufacture of heavy pumps and compressors on the plea that the demand in India would not justify the establishment of such a plant. Earlier, the Russians had agreed to prepare a technical and economic report for this project in the hope that at a later stage the plant could be included in the list of schemes to be undertaken with Soviet aid.

Copper Plan

Plans for India's electrolytic copper project are proceeding. The National Mineral Development Corporation Ltd. has now entered into an agreement with Western Knapp Engineering Co., of USA, for the consultancy services for the Khetri project. That company is to submit its report by the end of this year. Included in the country's third Five-Year Plan, the Khetri copper project envisages the production of electrolytic copper primarily for the electrical industry. Previously most supplies have been imported.

PAKISTAN

Power Commission

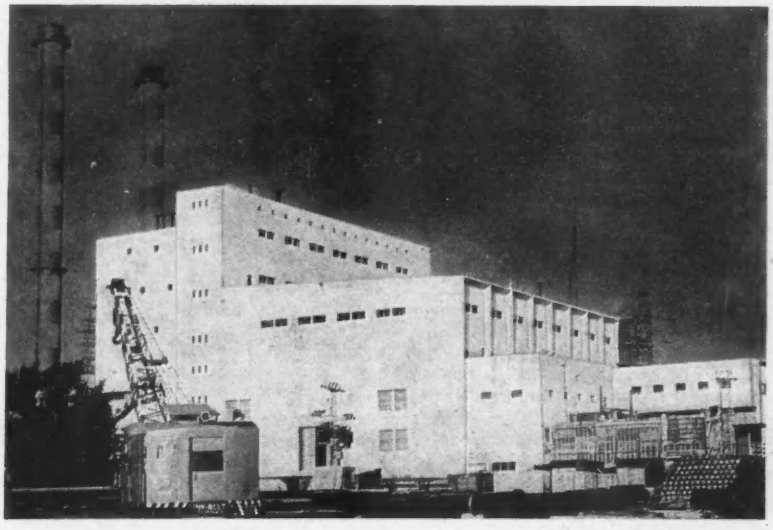
A ten-man Power Commission, empowered to assess the country's power requirements, sources of generation and distribution, and the rationalisation of tariffs, has been set up by the Government of Pakistan. Head of the Commission is Dr I. H. Usmani, chairman of the Pakistan Atomic Energy Commission. The new Commission is instructed to determine the power requirements of the country for the next ten years and beyond, and to recommend sources of power generation to meet the requirements.

Another Loan

An agreement for a DLF loan of $6 million to the Water and Power Development Authority of Pakistan for the construction of the Quetta thermal power station is expected to be signed in Washington this month. Tenders for the coal-fired station and plant have already been received and tabulated, and the Authority is expected to place orders very quickly following the signing of the agreement. Total cost of the project is estimated at $37·3 million. The site selected is at Sheikh Manda, four miles north of Quetta. Installed capacity of the station will be 15 MW, but there are plans for an extension to 30 MW which, it is judged, should be sufficient to meet the demand of the area until 1970. The present position is that a few diesel stations are producing 3,400 kW in an area of more than 20,000 sq miles with an approximate population of 300,000 persons. This situation has prevented the development of industry, the provision of irrigation facilities and the mechanisation of coal mines. The power station, when complete, will supply power to coal mines, irrigation projects for running tubewells and the Quetta Electric Supply Co. for distribution in the area, to industries and residential consumers outside the municipal limits. A dry cooling system is proposed.

ISRAEL'S NEW PLANT

The new 150 MW Haifa "B" power station of the Israel Electric Corporation Ltd. nearing completion. Commissioning of the first 75 MW set took place a few weeks ago, and the second machine is to be ready by the end of this year. Both are of German manufacture, purchased from reparation funds. Construction of a similar sized station has started at Ashdod, for completion by 1964. Mr Ya'acov Peled, general manager of the Corporation, has stated that two 10 MW gas-turbine generating sets are also to be installed



Company Activities

GUEST, Keen and Nettlefolds, Bowater Paper, and J. Lyons, giants in their respective fields, are the latest to underline the point I made here a month ago that the "squeeze" on margins is becoming increasingly widespread. A month ago the stock market was prepared to shrug off this threat. But not so last week. Guest, Keen announced that they do not expect 1961 to match the 1960 peak and that it will be difficult in this decade to maintain the rate of growth achieved in the past ten years. Sir Eric Bowater told his shareholders: "There is obviously a limit to our ability to offset by increased efficiencies these continually increasing costs," and J. Lyons and Co., with trading profit cut from £6,867,046 to £6,013,483, said that although turnover was actually higher increased costs more than offset the profit. And down dropped their £1 "A" shares by 9s 3d to 89s. Not to be outdone, the *Financial Times* equity index, on the same day as the Lyons result and the Bowater meeting, plunged 7·4 points to 344·1, the biggest drop since 28 Nov.

So no one would have expected the electrical share market to have shone last week. But if prices were for the most part dull there was nothing to suggest that the bottom was about to fall out of the market. AEI dropped 9d to 41s 9d and GEC was cut back from 36s 3d to 35s 6d, while English Electric, too, eased from 36s 3d to 34s 6d despite news of the £500,000 order to supply hydraulic constant speed generator drives for Vickers VC-10 airliners, the order for ten more 1,850 h.p. diesel locos for Sudan and the deal whereby Rolls-Royce will buy 50% of the aero-engine business of D. Napier, a wholly owned offshoot of EE. Main reason for the price cut was EE's £2m bid for W. H. Dorman.

Following the announcement of a strong rise in the profits of Reliance-Clifton Cables and the five-point increase in the dividend to 20%, last week saw more heartening results from Johnson and Phillips. Group sales in 1960 it is now revealed were £1 million higher than in 1959 at £10 million and there is a trading profit of £24,171 against a previous loss of £91,084. It enables Mr W. Glass to return the company to the dividend list with 5%. At the same time, there is an overall deficit of £6,452 after tax and the now "edgy" Exchange marked the £1 Ordinary shares down 4½d to 22s 6d.—*By our City Correspondent.*

W. H. Allen

Profit is down and the dividend is 10%, the minimum forecast with the scrip issue. The parent company's pre-tax profit is £236,420 lower at £667,210.

Allen West

More business than ever before in the year to 31 Jan. resulted in only steady net profit of £407,485 (previously £408,168). Much of the cause was excessive overtime to meet the pressure of orders, which were 20·9% higher than in the previous year, with the new 42-hr week and overcrowding aggravating the position. Output rose 12·8%, but the trading surplus only 3% to £1,005,660. To meet the situation, the company is following on the heels of the builders into a new building, and foundations of factory No. 6 are being laid. Price for the forthcoming one-for-ten rights issue is not yet disclosed.

Year to 31 Jan.	Trading Profit £	Net Profit £	% on Ord.		Ord. Price (Calendar year)	
			Earned	Paid	High	Low
1957	1,287,128	470,821	46·7	15	13/9	9/3
1958	1,418,264	489,416	37·3	12½*	13/7	7/8
1959	1,125,832	433,004	25·8	12½*	15/9	11/3
1960	976,109	372,306	22·2	13½	17/7	10/6
1961	1,005,660	368,203	22.0	13½	14/9	

* Scrip issues took place in both these years, lifting capital 50% in all.

Automatic Telephone and Electric

The market was taken aback by a fall in profit from £1,543,198 to £1,065,507, in view of Ericsson's higher earnings and the green light to the Post Office on development. Preliminary figures show after-tax profit down £364,395 at £710.791. However, dividend is maintained at 17%, now covered only 1·3 times.

Drayton Regulator

Rapid expansion continued last year, with new partnerships for medical equipment in India, and directors are contemplating long-term borrowing as the means of finance. The heating controls subsidiary is to enter the control installation field in order to maintain its position. In general, trade is "buoyant but competitive," and sales are ahead of last year. The annual meeting approved a change of name to Drayton Controls Ltd.

Elliott-Automation

Details of 1960's group profit of £1,776,510 are shown in the full accounts. It includes Rheostatic's earnings for 12 months, but only nine months' profit of that company's overseas subsidiaries. The Rheostatic group contributed £520,648, against a forecast £500,000. Excluding Rheostatic, profit rose 24% to £1,255,862 before tax. Turnover is revealed for the first time—up 25% to £20 million. In the current year, both sales and profits are showing an upward trend.

Louis G. Ford Ltd.

This firm of southern county electrical wholesalers and builders' materials suppliers are lifting their dividend from 27½% to 30% for 1960, and forecast a 10% interim in the current year against 6¼% previously. Earnings rose by £22,635 to a record £254,282.

Johnson and Phillips

A start on the road to recovery has been made with a trading profit of £24,171 for 1960, contrasting with 1959's loss of £91,084 plus a tax liability of £71,000 for that year. But considering that turnover in the past year was a record £10 million, earnings are disappointingly small. They fall short of Preference charges, let alone the 5% Ordinary dividend which directors now recommend, so satisfaction at a return to the dividend list is likely to be lukewarm. (The only payment in 1959 was a 3% capital distribution following the sale of shares in BICC.)

Kango Electric Hammers

A one-third rise in output, following the installation of new machine tools, was behind last year's record profit, the chairman reveals. The proportion of exports was maintained at over 50%. New markets are being explored and the trading outlook remains favourable.

Max Stone

A creditable performance is reported by this electrical retailing subsidiary of Firth Cleveland. Profit eased from £407,212 to £391,656 and dividend is held at 50%.

Stone-Platt

Group profit recovered from £2,106,536 to £2,409,826 in 1960 and the dividend is effectively raised by 1% to 16%. Net profit is £269,178 higher at £1,345,502 and dividend absorbs £885,998.

John Thompson

Directors had already warned shareholders of a "substantial loss" in 1960, and this is now revealed to be £1,776,511 (net profit in 1959 was £324,311). The setback is due to the writing off of £1,687,0000 on Berkeley and £516,000 on an Australian contract. There is no final dividend, so distribution for the year is 5% (previously 20%).

Walsall Conduits

Profit before tax is up from £666,047 to £741,810 and dividend is maintained at 15%. Tax absorbs much of the extra earnings, so net profit is only £9,529 higher at £368,236. Dividends absorb £134,750.

Dividends Declared

Crompton Parkinson. Interim 5% (*same*).

Efco. 2nd interim 7½%; year 11¼%. (Previous equivalent 10%.) Rights issue to raise £250,000 proposed.

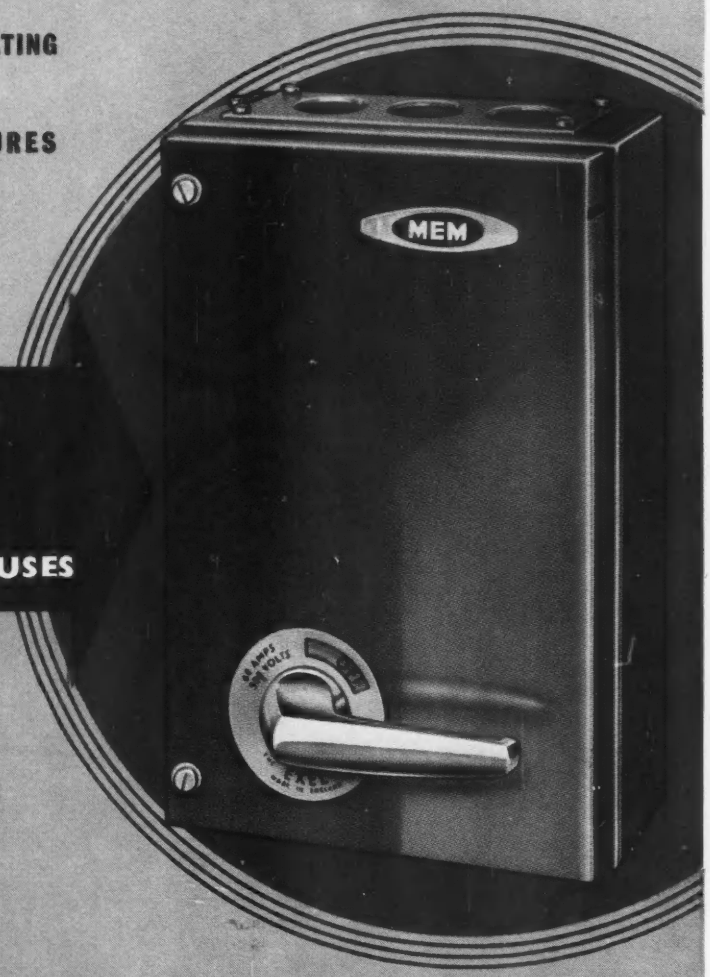
MEM introduce a new range of 500 volt SWITCHGEAR

CHROME PLATED FRONT OPERATING SWITCH HANDLES

FABRICATED STEEL ENCLOSURES

SEMI-ENCLOSED REWIRABLE OR H.R.C. CARTRIDGE FUSES

15, 30, 60, 100 AMPS



'EXEL'

SWITCHES AND SWITCHFUSES

- Fabricated cases are of heavy gauge sheet steel with hinged covers, rustproofed and finished grey stove enamel.
- The "Exel" range is fitted with chrome plated front operating switch handles, a feature which permits more compact assemblies on switchboards or panels.
- The "ON" and "OFF" positions are clearly shown by an indicator associated with the switch handle.
- Fuse bases are of the new "Kantark-Exel" pattern, which will accept semi-enclosed rewirable or H.R.C. cartridge fuse carriers.
- M.E.M. H.R.C. cartridge fuse carriers are designed to accommodate H.R.C. cartridge fuse-links to B.S.88:1952, Appendix 'J' Dimensions, Form A—Offset Tags.
- M.E.M. H.R.C. cartridge fuse-links are available for use with this range of switchgear, and have been A.S.T.A. certified for Category of Duty 440 AC3 (16,500 amps), 440 AC4 (33,000 amps) and 440 AC5 (46,000 amps).
- "Exel" switches comply with the relevant Temperature Rise, and Making and Breaking Capacity Tests of B.S.861: Part 1, 1955, and switchfuses with B.S.2510:1954.

. . . and so many other features, too

Write for M.E.M. List No. 450

MEM

MIDLAND ELECTRIC MANUFACTURING CO. LTD., REDDINGS LANE, TYSELEY, BIRMINGHAM 11

Wylex build quality into Switch Fuse Control Unit

1. Earth Bar always provided.
2. All Terminals easily accessible.
3. High grade electrolytic copper Bus-Bar.
4. Current-carrying components mounted on non-track Mouldings.
5. Fuse Contact Clips of Special design to ensure positive contact.
6. Ample wiring room.
7. Screws have domed ends — cannot cut into cables.
8. Incorporates WYLEX Switch — proven by years of extensive service.

Quality!

that's the *extra* — that costs you no more — in all products by Wylex. This range of Switch Fuse Control Units is available All-Insulated in 1, 2, 3, 4, 6 and 8 way and Metalclad 3, 4, 6 and 8 way, 250v. S.P.&N. Especially easy to stock and make up, to any combination of fuses — rewirable or cartridge. Features the *proven* WYLEX switch with silver-to-silver contacts and sturdy mechanical components.

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contemporary to the ra... of Switch Fuse Control U... available in 4, 6 and 8 w... All-Insulated and Metalc...

Wylex build quality into . . .

SWITCHES · SWITCHED SPUR BOXES · PLUGS & SOCKETS
COOKER UNITS · SWITCH FUSE CONTROL UNITS

GEORGE H. SCHOLES & CO. LTD. Wylex Works, Wythenshawe, Manchester

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders unless otherwise stated.

8 June—Bellshill. (1) Heavy fixed cooking equipment; (2) kitchen equipment, including mixing and washing machines; (4) refrigerators for Maternity Hospital. Applications to Group Secretary and Treasurer, Hairmyres Hospital, East Kilbride.

8 June—Harrow B.C. 15 sodium units, 1,300 2 by 20 W fluorescent units and 150 2 by 40 W fluorescent units.—See 1 June issue.

8 June—Heston and Isleworth B.C. 23 double-arm and six single-arm columns with 400 W mercury fluorescent aero-screened lanterns/gear.—Advertised 25 May issue.

8 June—N. Ireland. Electrical installation in Groomsport (new) primary schools.—See 1 June issue.

8 June—Wood Green B.C. 155 Group "A" concrete columns; (b) provision of 40 140 W sodium lanterns/gear; (c) provision of 115 3 x 80 W fluorescent lanterns/gear. —See 25 May issue.

9 June—Hereford T.C. Wiring of 147 houses and 12 bungalows on Newton Farm Five estate.—Advertised 18 May issue.

9 June—Peterborough. Lighting and power installations in police house and office, Mountsteven Ave, for Combined Police Authority. Authority Surveyor, Town Hall. Deposit £2.

9 June—Westport, Co. Mayo. Factory installation.—See 25 May issue.

10 June—Heywood B.C. Supply of: (1) 50 W so/h lanterns; (2) transformers and capacitors; (3) controllers; (4) columns.—See 25 May issue.

12 June—Dagenham B.C. Electrical installations in 52 houses, Oxlow La estate.—See 1 June issue.

12 June—Durham C.C. Supply: laboratory equipment.—See 1 June issue.

12 June—Enniskillen B.C. Conversion of mercury to fluorescent street lighting.—See 25 May issue.

12 June—Hetton U.D.C. Supply: electrical equipment.—See 1 June issue.

12 June—Romsey B.C. Installation of power points in 160 pre-war houses.—See 25 May issue.

12 June—Sedgley U.D.C. 125 Group "B" 80 W mercury fluorescent lighting units on 25 ft concrete columns.—See 25 May issue.

13 June—Cheshunt U.D.C. Provision of metal extension brackets, plus erection and wiring of concrete columns/brackets/200 W sodium lamps/gear.—See 25 May issue.

13 June—Neath R.D.C. Installations in 74 houses.—See 1 June issue.

13 June—West Riding C.C. (4) Rewiring of Westerton J.M.I. School.—See 18 May issue.

13 June—W. Riding C.C. Applications invited for inclusion in approved list.—See 1 June issue.

15 June—Bridge of Allan B.C. Electrical work in erection of 15 two-apartment and three three-apartment houses, Allandale Rd. —See 1 June issue.

15 June—Manchester C.C. Supply of (a) 206 G.E.C. sodium lanterns/gear; (b) 203 "Byway" and "Midway" concrete columns; (c) 206 Sangamo timeswitches.—Advertised 1 June issue.

15 June—Workington B.C. Erection complete of 62 Class "A" concrete columns with sodium lighting. Borough Engineer and Surveyor, Stoneleigh, Park End Rd.

16 June—Lanark C.C. (1) 42 140 W sodium lanterns/gear for A8 Salsburgh scheme; (2) (a) 50 140 W sodium lanterns; (b) 50 transformers; (c) capacitors for A8 Harthill scheme.—Advertised 25 May issue.

16 June—Slough B.C. (7) Electrical installations in 238 houses, Parlaunt Pk, Langley. Applications to Borough Engineer, Town Hall, by above date.

17 June—Whitchurch U.D.C. Dismantling of existing lighting and supply/erection/fitting of 70 30 ft steel columns and 200 W sodium lighting.—Advertised 25 May issue.

19 June—Brighton. Electrical installation, on fixed-price basis, in Brighton, Hove and Sussex Grammar School for Joint Education Committee. Borough Surveyor, Engineer and Planning Officer, 26-30 King's Rd, Brighton. Deposit £1 1s.

19 June—Dearne U.D.C. Rewiring of 64 houses, Carby Hall estate.—See 1 June issue.

19 June—Ennerdale R.D.C. Supply and erection of ten m.v. street lighting units at Parton. Engineer: J. Leigh, Council Offices, Cleator.

19 June—Manchester C.C. Contract 301. Electrical installations in 353 dwellings, Councillor La, Cheadle. Director of Housing, Town Hall.—Advertised in this issue.

19 June—Stocksbridge U.D.C. 255 60 W sodium lighting on 15 ft concrete columns. —See 25 May issue.

24 June—Belper U.D.C. Supply, erection and wiring of 14 Stanton columns with A.E.I. post-top fluorescent lanterns in King St. Engineer and Surveyor, King St.

26 June—Bury C.B.C. Electrical installation, alterations, etc., in abattoir extensions. Details from architect: T. R. Duckworth, 30 St. James St, Accrington.

26 June—Llanelly B.C. Connection of 166 street lights to mains supply. Borough Engineer and Surveyor, Town Hall. Deposit £2 2s.

28 June—Cockermouth U.D.C. 16 street lighting units. Surveyor, Town Hall.

28 June—Gt. Yarmouth C.B.C. (b) Electrical installation, on fixed-price basis, in H.Q., police station and area control premises at Howard St South. Borough Engineer, Town Hall. Deposit £2 2s.

28 June—Middlesex C.C. Supply and erection of 14 steel columns, mercury lamps, lanterns, gear and wiring for lighting Wraysbury roundabout, Staines By-pass. County Engineer and Surveyor, Middlesex Hse, 20 Vauxhall Bridge Rd, S.W.1. Deposit £5.—Advertised in this issue.

28 June—Trim U.D.C. Duplicate 125 g.p.m. pumps.—See 1 June issue.

29 June—Wortley R.D.C. Supply/installation of 32 cookers.—See 25 May issue.

30 June—Belfast C.C. Supply and erection of air heater element cleaning equipment at Power Station West.—Advertised 1 June issue.

1 July—Bristol C.C. Operating gear for a centre bearing 900-ton swing bridge. Applications, giving details of previous similar experience, to City Engineer and Planning Officer, Cabot Hse, Deanery Rd, by above date.—Advertised in this issue.

3 July—Clowne P.C. Provision and erection of 115 Group "A" concrete columns and sodium lighting along A616 and A618. Council Clerk: L. Howe, 4 Harlesthorpe Ave, Clowne, near Chesterfield. Deposit £2 2s.—Advertised in this issue.

3 July—West Riding C.C. Rewiring, including emergency lighting system, at Fairfield Hall, Addingham, Ilkley. Divisional Architect, Salisbury Bldgs, Albert St, Harrogate. N.I.C. roll number required.

5 July—Manchester C.C. Electrical installation in extensions to Elizabeth Gaskell College.—See 1 June issue.

No date stated—Ayr C.C. Supply of: (1) concrete columns; (2) electrical equipment; (3) 140 W so/h lanterns; and (4) erection, for Kilwinning By-pass roundabout lighting. —See 18 May issue.

No date stated—Somerset C.C. Supply: heavy duty cooking equipment, water heaters, potato peelers, mixing machines, etc.—See 25 May issue.

No date stated—Whitby U.D.C. 131 Group "A" steel octagonal columns and 250 W colour-corrected mercury lanterns/gear.—See 1 June issue.

. . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon Hse, Theobalds Rd, W.C.1, quoting reference.*

14 June—Australia. 14 400 A switchboards. Secretary, Victorian Railways, Melbourne C.1. B.o.T. (ESB/17060/61).*

15 June—America. One 300 kW diesel generator. Mobile Corps of Engineers, Bldg 3, 2301 Airport Boulevard, Mobile, Alabama. B.o.T. (ESB/17411/61).

15 June—Greece. Insulators (five items). Ministry of Trade, 50 Socratous St, Athens. B.o.T. (ESB/17840/61).*

17 June—Ecuador. Measuring apparatus and instruments (21 items) and apparatus for practical work on electromagnetism (22 items) and other laboratory equipment. School Secretary, Quito National Polytechnic School, Quito. B.o.T. (ESB/17500/61).

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources, including an index of trade information with over 100,000 entries

A Selection from the 112 queries answered this week

"Elna" sewing machine motors—agents for? S.E.B.—Leighton Baldwin (Sales) Ltd., 365 Euston Rd, N.W.1.

"Vicsol" soldering irons—makers of? L.E.B.—T. Leeman and Co. Ltd., 34 Palmerston Rd, South Acton, W.3.

"Skilsaw" electric tools—agents for? Y.E.B.—British Equipment Co. Ltd., Ixworth Hse, Ixworth Pl, South Kensington, S.W.3.

"Pearl" kettles—makers of? L.E.B.—Pearl Industries Ltd., Factory Centre, King's Norton, Birmingham 30.

Instantaneous water heaters—makers of? T.E.—"Clage": F.G.S. Ltd., 1 Rodney Gdns, West Wickham, Kent; "Hewi": Pemlec Ltd., Capel Hse, New Broad St, E.C.2; "Jack-Daw": J. Daw (Productions) Ltd., Lower Essex St, Birmingham 5; "Kent": I.C.G. Ltd., The Royal Assembly Room, The Pantiles, Tunbridge Wells, Kent.

"Lindner" lighting fittings—makers of? W.W.—Loblite Ltd., Third Ave, Team Valley, Gateshead-on-Tyne 11.

ANSWER WANTED

"Bel-therm" electric blankets—suppliers of? M.P.—

CORRECTION

"Cebe" drawing board light—suppliers of? S.W.E.B.—We are informed that M. J. Glover and Co. (London) Ltd., 8 Evelyn Grove, Ealing, W.5, are the sole concessionaires in this country.

18 June—Kuwait. Eight 12·6 kVA 415/240 V portable welding transformers. President, Dept. of Electricity, Water and Gas. B.o.T. (ESB/17869/61).

22 June—India. Two 400 kVA, 3-ph. 11 kV/550 V transformers. Chief Purchase Officer, National Coal Development Corpn., Darbhanga Hse, Ranchi. B.o.T. (ESB/17888/61).

23 June—S. Africa. One three-panel and one four-panel 6·6 kV switchboard. Chairman, Tender Board, P.O. Box 7784, Johannesburg. B.o.T. (ESB/17045/61).*

25 June—Iraq. Hard-drawn stranded copper wire, binding wire and connectors. Director-General, Iraqi Ports Administration, Margil, Basrah. B.o.T. (ESB/18041/61).*

26 June—India. 38 11/·415 kV indoor distribution transformers of 300, 500 and 750 kVA. Chief Engineer (South), Stores Purchase Section, Punjab S.E.B., The Mall, Patiala. B.o.T. (ESB/17819/61).

26 June—India. 15 kW induction heating furnace for Director, Indian Bureau of Mines, Nagpur. Inquiry S.E.382 details, fee 14s 4d, from India Store Dept., Government Bldg, Bromyard Ave, W.3. Viewing reference S.3121/61/NSC/ENG2.

28 June—Rhodesia and Nyasaland. Three 1·25, 3 and 5 kVA 230 V emergency lighting generators. Town Clerk, P.O. Box 591, Bulawayo. B.o.T. (ESB/18090/61).*

29 June—America. Advance notice: control switchboards and accessories for Bull Shoals dam and reservoir. U.S. Corps of Engineers, Little Rock District. B.o.T. (ESB/17054/61).*

30 June—India. (a) Automatic multi-aspect colour light signalling 8½ mile double line Chandil-Kandra; (b) similar signalling equipment eight mile Kandra-Sini; (c) panel interlocking at Kunki. Details, on receipt of £1 2s 6d fee receipt by Chief Cashier, from Chief Signal and Telecom. Engrs., S.E. Railway, Garden Reach, Calcutta 43.

30 June—Singapore. Telecommunications and measuring equipment (20 items). Assistant Registrar (Finance), Singapore Polytechnic, P.O. Box 2023. B.o.T. (ESB/18086/61).*

3 July—Pakistan. One each 1 kVA, 6 kVA and 25 kVA diesel-alternators. Mr F. Rizwi, Purchase Co-ordinating Officer, Pakistan Posts and Telegraphs, Directorate General, Karachi. B.o.T. (ESB/17900/61).*

5 July—India. 138 kV pedestal insulators for Chandrapura Power Station, Damodar Valley. India Supply Mission, 2536 Massachusetts Ave, N.W., Washington 8, D.C., U.S.A. B.o.T. (ESB/17814/61/DLF).

6 July—India. 30 A to 200 A 500 V t.p. switchfuses. Chief Engineer (South), Stores Purchase Section, Punjab S.E.B., The Mall, Patiala. B.o.T. (ESB/16844/61).

10 July—Australia. 15 750 MVA and 12 1,500 MVA 66 kV circuit-breakers and current transformers. Manager and Secretary, E.C. of N.S.W. Box 5257, G.P.O., Sydney. B.o.T. (ESB/17427/61).

10 July—Pakistan. Two 10 kW and one 20 kW diesel generator. Chief Controller of Stores, P.E. Railway, Pahartali, Chittagong. B.o.T. (ESB/17425/61).

10 July—Trinidad and Tobago. 200 45 W 240 V so/h lamps. Purchasing Officer, Electricity Commission, G.P.O. Box 121, Port-of-Spain B.o.T. (ESB/17070/61).

11 July—Ceylon. 2,000 pin-type 33 kV insulators. Chairman, Tender Board, Ministry of Agriculture, Land, Irrigation and Power, P.O. Box 500, Colombo. B.o.T. (ESB/17492/61).*

14 July—Iceland. One hydraulic turbine for the Irafoss Power Station on the Sog River, Sogsvirkjunin, Reykjavik. B.o.T. (ESB/17889/61).

17 July—India. Insulators pin and disc (three items). Chief Engineer (South), Stores Purchase Section, Punjab S.E.B., The Mall, Patiala. B.o.T. (ESB/17820/61).

23 Oct.—Australia. Two 1,650 klb/hr, 1,500 p.s.i. at 1,050°F boilers/buildings and coal handling plant for Stage II Hazelwood Power Station. Specification 61-62/1 details from Agent General for Victoria, Victoria Hse, Melbourne Pl, Strand, W.C.2.

27 Oct.—Australia. Two steam boilers complete with automatic control and instruments for Bulimba "B" Power Station. Chief Engineer, Southern Electrical Authority of Queensland, Boundary St, Brisbane. B.o.T. (ESB/17022/61).*

TRADE NOTES

Name change. The title of Drayton Regulator and Instrument Co. Ltd. has been changed to Drayton Controls Ltd.

New concern. Recently formed for the manufacture of all the printed circuit and chemical etching interests of the Ayling Industries Group is a new company, Bribond Printed Circuits Ltd. The company takes over the activities of the Printed Circuit Division of Bribond. Work will be concentrated at one of the Group's factories on the Chichester industrial estate. A machine for the automatic manufacture of printed circuits has recently been installed by the company.

Gazette Announcements

COMPANIES ACTS

Gallagher and O'Brien Enterprises Ltd. Creditors to send details to liquidator: R. A. Haigh, Court Chmbrs, Friar La, Leicester, by 17 June.

S. and R. Domestic Appliances (Wakefield) Ltd. Creditors to send details to liquidator, R. W. Hellyer, Brotherton Chambers, Westgate, Leeds, by 23 June.

Home Electronics (Bradford) Ltd. Mr R. W. Hellyer, Brotherton Chmbrs, Westgate, Leeds 1, appointed liquidator as from 10 May.

D.E.S. (Sewing Machines) Ltd. Liquidator: F. M. Collins, Inveresk Hse, 346 Strand, W.C.2, released as from 28 April.

Flowmeter Mnfg. Co. Ltd. Liquidator: G. A. Raymond, 40 High St, Chatham, released as from 22 March.

MetroPex Ltd. Liquidator: A. T. Cheek, Inveresk Hse, 346 Strand, W.C.2, released as from 3 May.

P. and B. Electrics Ltd. Petition for winding-up to be heard before the High Court of Justice, Strand, W.C.2, on 12 June. Persons intending to appear to notify A. E. Samuels and Co., 292 High Holborn, W.C.1, by 4 p.m., 9 June.

Kevin Electrical Industries Ltd. Petition for winding-up to be heard before the High Court of Justice, Strand, W.C.2, on 12 June. Persons intending to appear to notify A. E. Samuels and Co., 292 High Holborn, W.C.1, by 4 p.m., 9 June.

L. and I. Clarke Electrical Co. (Portslade) Ltd. Mr J. S. Bradley-Hole, 7 Old Steine, Brighton 1, appointed liquidator at extraordinary general meeting on 24 May for the purpose of voluntarily winding-up.

Guest Electrical Co. Ltd. Meeting of creditors to be held at No. 2 Conference Room, Royal Pavilion, Brighton, on 8 June, at 2.45 p.m.

Estreich Electrical Co. Ltd. Meeting of members and creditors to be held at 65 London Wall, E.C.2, on 30 June, at 12.15 and 12.30 p.m., respectively.

BANKRUPTCY ACTS

Receiving Order

High Court of Justice. R. S. Merryweather, electrical dealer, trading as Merryweathers, of 71 Cricklewood La, N.W.2, and lately carrying on business at 43 Mill La, N.W.6 Receiving order dated 17 May.

First Meeting and Public Examinations

Birkenhead. E. J. Jones, electrical contractor and domestic appliance dealer, carrying on business at 3 Tetbury St. Public examination: 10.30 a.m., 3 July, at Court Hse, Pilgrim St, Birkenhead.

High Court of Justice. A. J. Cicale, electrical dealer, of 385 Nether St, N.3. Public examination: 11 a.m., 13 July, at Bankruptcy Bldgs, Carey St, W.C.2.

Blackwood, Tredegar and Abertillery. J. Jones, radio, television and electrical goods dealer, formerly carrying on business at 74 High St, Blaina. Public examination: 11 a.m., 1 Aug., at County Court, Blackwood Rd, Blackwood, Mon.

High Court of Justice. R. C. Gibson, appliance distributor, trading as R. C. Gibson and Co., of 112 Brondesbury Villas, N.W.6. First meeting: 11.30 a.m., 8 June; and public examination: 11 a.m., 28 June, both at Bankruptcy Bldgs, Carey St, W.C.2.

Kingston upon Hull. F. Sutton, electrical goods retailer, formerly carrying on business as Swift Electrics, at 8 Southcoates La. Public examination: 10.30 a.m., 17 July, at The Guildhall, Hull.

Brentford. H. McConkey, electrical equipment distributor, formerly carrying on business at 163 Cavendish Ave, W.13. Public examination: 10.30 a.m., 14 July, at Court Hse, Half Acre, Brentford.

Application for Discharge

High Court of Justice. K. W. Roberts, electrical goods dealer, formerly carrying on business as K. Roberts Electrical, at 1-3 Oglander Rd, S.E.15. Order made on 21 April on application for discharge: discharged as from 21 April, 1963.

Intended Dividend

Hastings. W. O. Curry, electrical contractor, formerly carrying on business at 1 Tynevale Terr, Leamington-on-Tyne. Last day for receiving proofs for intended dividend: 9 June, by trustee: J. S. Bradley-Hole, 7 Old Steine, Brighton 1.

CONTRACTS PLACED

Cardiff C.C. Lift instaliation in Fairwater Home, H. Breakell and Co. (Blackburn) Ltd., £1,635. Recommended.

C.E.G.B. (S.E. Region). Contracts placed during May amounting to £541,519, include: Bengeworth Rd, Brixton, 132 kV switchgear, A.E.I. Ltd.—East Ham, 2-15 MVA 66/11 kV transformers, Ferranti.—Eltham, 33 kV switchgear, G.E.C. Ltd.—St. Marylebone, 66 kV switchgear mods., A.E.I. Ltd.—Sydenham, 33 kV switchgear, A. Reyrolle and Co.—Ashford, 2-45 MVA 132/33 kV transformers, Bonar Long and Co.—Northfleet, 1-45 MVA 132/33 kV transformers, Brush Elec. Eng. Co.—Purley, 132 kV switchgear, A. Reyrolle and Co.—Southern Cross and Fishergate, 132 kV switchgear, English Electric Co.—Three Bridges, civil works, J. L. Eve Const. Co.—Luton, 132 kV switchgear, A. Reyrolle and Co.—Norwich, civil works, R. G. Carter.—Burwell, installation of 2-45 MVA transformers, conversion of C.W. system, Fuller Electric Ltd.—Acton Lane, No. 5A turbo-alternator, Aiton and Co. Ltd.

Metropolitan Water Board. Supply of 3·3 kV motor control gear, etc., at Staines and Ashford Common pumping stations, Watford Electric and Mnfg. Co. Ltd., £16,178.

Newport B.C. Provision of improved street lighting in Chepstow and Somerton Rd, G.E.C. Ltd., £1,727. Recommended.

Redcar B.C. Erection of Coatham Enclosure and Promenade extension street lighting, A.E.I. Lamp and Lighting Co. Ltd., 1961/62 programme, Lea Valley Erectors.

Stepney B.C. Modernisation of 30 lifts on various housing estates, McGhee and Murray Ltd., £5,224. Recommended.

Welwyn Garden City D.C. Supply/erection/painting of 26 Group "A" and 48 Group "B" columns/lanterns/gear in N.E. residential development, Abacus Municipal Ltd.

BUSINESS PROSPECTS

Aylesbury. W. Russell Orme and Ptnrs., 55 Manchester St, W.1, architects for proposed shops/offices development, George St, proposed by London and Burtley D.C.

Ayr. British Replin Ltd., 20 Belvedere Terr, propose factory/offices, Heathfield. Architects: Stevenson and Ferguson, 17 Barns St.

Bakewell R.D.C. Tender: 36 houses and two blocks of three old people's flats, Bradwell housing site. Architect: Arnold Lowcock, King St.

Barry. Midland Silicones Ltd. propose £150,000 extensions to research and development laboratories. Contractors: Richard Costain (Construction) Ltd., Brunel Hse, St. George's Rd, Bristol.

Bedford. J. Crawley and Sons Ltd., Tavistock St, propose new showrooms/workshop for service station.

Beverley B.C. Tender: 29 dwellings, Lairgate/Keldgate redevelopment area. Clerk.

Bishop Auckland. Maypole Dairy Co. Ltd., propose supermarket, Newgate St.

Blackburn. Massey's Burnley Brewery Ltd., Bridge End, Burnley, propose hotel with theatre over, Commercial Hotel site.

Boldon U.D.C. propose 68 houses, Mill Farm estate, Whitburn. Gordon Durham and Co. Ltd., Bldrs, East Boldon, contractors for 54 houses, Sunniside Terr., Cleadon.

Boreham. Buxted Chicken Co. propose £350,000 chicken process factory. Contractors: Holland & Hannen and Cubitts (G.B.) Ltd., 1 Queen Anne's Gate, S.W.1.

Bristol C.C. Tenders: laboratories, Davy Hse; electrical engineering and metallurgy laboratories, Brunel Hse, Bristol College of Science and Technology. Education Officer.

Bromley. Kent C.C., Maidstone, propose £179,000 extensions to Raglan Hayesford Boys' Secondary School.

Buxton. Manchester Regional Hospital Board propose £119,000 chronic sick unit and nurses' accommodation, Corbar Hall Maternity Hospital.

Chatham B.C. Tender: 31 dwellings, Ordnance St, Perry St. Engineer. Richard Watts Charity propose departmental store, High St; architects: Read and McDermott, 18 High St, Maidstone.

Cheshunt. Herts C.C. propose secondary modern school with youth wing, Mill La. Cost £344,372.

Chester-le-Street. Wm. Leech (Builders) Ltd., 7 St. James's St, Newcastle, propose 54 houses, Whitelands estate, Birtley, and 92 on Wentworth Pk estate, Ouston.

Chichester. McAlpine and Sons Ltd., London W.1, contractors for festival theatre, Oaklands Park.

Corby. D.C. propose £55,000 youth centre. Corporation's Clerk.

Croydon. E. Piper, 16 Cedars, Walk, Kenley, proposes factory/offices, Gladstone Rd.

Cumberland. C.C. propose comprehensive school for 1,600 pupils, Egremont. County Architect, Portland Sq, Carlisle.

Cumbernauld D.C. Tender: two single-storey standard factories, 18,400 sq ft and 3,700 sq ft, Blairlinn site. Chief architect, Cumbernauld Hse, Cumbernauld, Glasgow.

Darlington. North and Ptnrs., 40 Broadway, Maidenhead, architects for proposed Ravenscroft Properties Ltd. shops, Northgate.

Ditton. R.C. Diocese of Southwark propose primary school with church, Hampton Court Way.

Dover. Sir Hugh Casson, Neville Conder and Ptnrs., 35 Thurloe Pl, S.W.7, architects for proposed 20-storey flats surrounded by office blocks, Townhall St. Cost £1 million.

East Barnet. Herts C.C. propose £241,486 adaptations, extensions to East Barnet Grammar School.

Edenbridge. Roscoe and Howard Ltd., 124 Aldersgate, E.C.1, propose new factory.

Farnborough. Hospital Management Committee plan new physiotherapy and casualty dept., Farnborough and Cove Hospital.

Glenrothes. D.C. propose two new factories, Queensway industrial estate. Corporation architect, Woodside, Glenrothes.

Glasgow C.C. Tender: new Allan Glen's senior secondary school. City Architect, 20 Trongate, C.1.

Glossop. Ferrostatics Ltd., Borough Wks, High St West, propose factory/offices, Shaw La.

Gosforth. P. J. Stienlet and Son, 4 Queen Sq, Newcastle, architects for proposed R.C. secondary school. R.C. Authorities also propose primary school. Child and Hall, 6 Archbold Terr., Newcastle, architects for extensions to St. Hilda's Training School for Girls, Salters Rd.

Grangemouth B.C. Tender: 99 houses, Airfield fifth development. Engineer.

Gt. Yarmouth. R. G. Carter Ltd., Drayton, Norwich, contractors for £90,000 Erie Resistor Ltd. factory.

Harlow New Town. Universal Postal Frankers Ltd., Angel Rd, N.18, propose £400,000 factory. Quality surveyors: Langdon and Every, 21 Russell Sq, W.C.1.

Hemel Hempstead. Proposed: Herts C.C. £276,730 new Halsey secondary modern school, Gadebridge.

Heston. Reed Mfg. Co. Ltd. propose £50,000 extensions to factory. Architects: W. E. and E. M. Cross, The Studio, Osterley Rd, Isleworth.

Hexham. C. Solomon, 30 St. Mary's Pl, Newcastle, architect for proposed Hadrian Supply Stores Ltd. supermarket, Fore St.

High Wycombe. Proposed: by E. M. F. Brown Ltd. new factory, Duke St. Architects: Thurlow, Lucas and Janes, 86 East St. Equity and Law Life Assurance Soc. Ltd., E.C.4, propose £100,000 extensions; architects: Brocklehurst, Cooper and Williamson, 39 High St.

Hinckley. U.D.C. propose development of industrial estate, Coventry Rd. Surveyor.

Huddersfield. Lunn and Lunn, Market St, Milnsbridge, architects for proposed £170,000 Y.M.C.A. hostel, Northumberland St.

King's Lynn. Norwich Union Insurance Soc., Surrey St, Norwich, propose 14 shops, 11 flats, New Conduit St.

Kingston upon Thames R.B.C. Tender: 32 flats, Penrhyn Rd/Surbiton Rd. Clerk.

Llanelly. Thyssen Shaft Sinking Co. Ltd., Cynheddrem, propose £100,000 H.Q.

Leamington Spa. Jay Reproduction Ltd., 16 New Meeting St, Birmingham 4, propose factory/office block, Queensway Trdg estate.

Leicester. W. and H. Foulds Ltd., Eastern Boulevard, to erect new factory for A. and G. Edginton (Leicester) Ltd., engravers, Rutland St.

Liverpool. Factory/offices, Ellis Ashton St, Huyton, proposed by G. H. Roberts (Liverpool) Ltd. Allied Suppliers Ltd., 179 City Rd, E.C.1, propose additional meat store and freezing facilities at their factory.

London. Leigh and Letcher Ltd., 27 Powell St, E.C.1, propose new premises, Emma St, E.2; contractors: J. Burley and Sons Ltd., 1 Brooklands Rd, Weybridge. T. P. Bennett and Son, 43 Bloomsbury Sq, W.C.1, architects for proposed London hospital. 12 shops, Bethnal Green Rd, E.2, proposed; architects: V. Bloom and Ptnrs., 12 Gloucester Pl, W.1. B.T.C., Marylebone Rd, N.W.1, propose shops/offices/warehouse/flats, Blackfriars goods depot. Multi-storey flats, Buckingham Palace Rd, planned by Morris de Metz, 29 Gloucester Pl, W.1. Town and Commercial Properties Ltd., 25 Grosvenor St, W.1, propose £100,000 offices, Caxton St. T. P. Bennett and Son, architects, 43 Bloomsbury Sq, propose shops/offices/flats, etc., concourse to Marylebone Station.

Loughrea. Tender: new factory for Honner Panoramic Ltd., Dublin; A. G. Jennings and Asscts, engineers and architects, O'Connell St, Sligo.

Luton. £30,000 spastics centre proposed by Luton and Dunstable District Spastics Group. Architects: C. W. Shrimplin, 7 Upper George St, Luton.

Manchester. Small and Parkes Ltd. propose factory extensions, Hendham Vale Wks, Harpurhey. Factory extensions, Score St, Bradford, proposed by Mitchells Grinding Wheel Co. Ltd. Five-storey offices with restaurant, Cheapside, planned by Commercial Investments Ltd. £50,000 new science block proposed at Manchester Grammar School, Old Hall La, Fallowfield. Board of Governors.

Market Bosworth R.D.C. Tender: extensions to council offices. Surveyor.

Middlesbrough. T.C. propose 50 houses, Dunstable Rd. Tenders: 41 dwellings, St. Hilda's and 33 dwellings, Easterside.

Newburn. Percy L. Browne and Son, Pearl Bldgs, Northumberland St, Newcastle, architects for proposed community centre, West Denton.

Newcastle. Federated Properties Ltd., Southend, Fernwood Rd, Jesmond, propose conversion of Regal cinema, Two Ball Lonnen, into business premises. John T. Bell and Sons, Builders, Market Chmbrs, New Market St, propose five-storey offices, Archbold Terr. Newcastle and District Dairies, Bunton Pk Rd, propose extensions; architect: L. Auton, Regent Bldgs, York Rd, West Hartlepool. P. J. Stienlet and Son, 4 Queen Sq, architects for proposed R.C. Secondary Modern School, West Denton.

Newport. M.o.W. propose seven-storey offices, Cheapstow Rd. M.o.W. architects' dept., Abell Hse, John Islip St, S.W.1.

Northampton. Newilton Ltd. propose four-storey building, Derngate, with basement shopping area and seven ground-floor shops. Wilson's Bldrs (Northampton) Ltd.

North Riding C.C. Further tenders for infants' school, Ormesby; architect, D. C. Hall, Duke St, St. James's, S.W.1; and junior school, Malton; architect, W. W. Atkinson, 4 Raymond Bldgs, Gray's Inn, W.C.1.

Nottingham. Fitzroy Robinson and Ptnrs., 3 Gray's Inn Sq, W.C.1, architects for proposed £750,000 multi-storey block for Mechanics' Institute. Offices / laboratory / chemical block, Island St, proposed by Boots Pure Drug Co. Ltd.

Oadby. U.D.C. propose 40 dwellings, Kenilworth Drive. Surveyor.

Ormskirk. Willink and Dodd, Royal Liver Bldgs, Liverpool, architects for proposed £250,000 supermarket/shopping centre, Moor St.

Oundle. Proposed: private housing estate, Lime Ave, by Stirton and Ptnrs., Bldrs, Ltd., St. Mary's Pl, Stamford.

Oxford. £50,000 works dept. planned by J. Clark and Easton, Scoresby Hse, Glasshill St, S.E.1.

Peterborough. Education Board propose new county primary school, West St, Helpston. Board Architect, Bridge St.

Poole. Proposed: 20-lane bowling centre, costing £250,000, Poole Rd, Branksome. Brunswick Bowling Ltd.

Port Glasgow. Sangamo Weston Ltd., Gt. Cambridge Rd, Enfield, propose factory extensions, Industrial Estate, costing £150,000.

Prudhoe. King's College, Newcastle, propose residential block for 300, Close Hse, Wylam.

Ramsgate. Allnatt (London) Ltd., Battle, Hastings, contractors for Hirst Electronic Ltd. factory.

Redhill. Federation Mutual Assurance Ltd. propose £50,000 office extensions. Architects: J. R. S. Stammers, Alders Rd, Reigate.

Rotherham. Kenyon, Son and Craven Ltd. propose factory extensions, Fitzwilliam Rd.

Rhyl. Welsh Regional Hospital Board, Cathays Park, Cardiff, propose new base hospital, Rhudland Rd.

Rochdale. Manchester Regional Hospital Board, Cheetwood Rd, propose £119,274 out-patients' dept., Rochdale Infirmary.

Ruislip. Murray Ward and Ptnrs., 32 Wigmore St, W.1, architects for proposed B.E.A. printing works, South Ruislip.

Business Prospects—continued

Runcorn. Metro-Cutanit (Warrington) Ltd., Allen St, Warrington, propose factory, Grappenhall.

St. Helens. Delta Metal Co. award contract for new factory to Robert M. Douglas (Contractors) Ltd., 396 George Rd, Birmingham 23.

Salford. Harry S. Fairhurst and Son, 55 Brown St, Manchester 2, architects for proposed new works/offices, New Bailey St, for *Manchester Evening News*, Cross St.

Seaham. U.D.C. propose 100 houses, Northlea. Surveyor.

Sheffield. Planned: 90-bedroom hotel/shops, Cambridge St, to cost £1 million. Architects: Fowler and Marshall, 15 St. James's Row, Sheffield.

Skegness. Stiebel and Co., Esco Hse, Stoney St, Nottingham, propose new factory.

Smethwick C.B.C. Tender: 21 old people's flats, Perry Hill, Oldbury. Engineer.

Southend. Hickle and Durkin, 30 Queen Anne's Pl, W.1, architects for proposed ten-storey offices, Victoria Ave.

Stevenage. A. Monck and Co. Ltd., 75 Victoria St, S.W.1, contractors for £143,000 Taylor Controls Ltd. factory.

Sunderland. T.C. propose two old people's hostels; architect: Stockton Rd. Spastics Soc. propose new workshops; architects: Newrick and Blackbell, 58 John St.

Surbiton. Donaldson and Co., 75 London Rd, Kingston upon Thames, propose £70,000 showrooms/flats, St. Mark's Hill.

Sutton. Percy V. Burnett and Ptnrs., 1 Bloomsbury Sq, architects for proposed £140,000 flats/offices, Cock Hotel site, High St.

Towcester. Plessey Ltd., Wood Burcote Way, propose canteen, electronic factory.

Tynemouth. Snowdon Bros, Handel St, Sunderland, contractors for Vaux and Assoc. Breweries public house, Queen Alexandra Rd.

Walthamstow. Y.M.C.A., Gt. Russell St, W.C.1, propose £200,000 hostel and club, Forest Rd.

Welwyn Garden City. Jas. Cubitt and Ptnrs., 25 Gloucester Pl, W.1, architects for proposed £400,000 Roche Products Ltd. five-storey production building, Broadwater Rd. I.C.I., Millbank, S.W.1, propose engineering research building, Black Fan Rd. Architects: J. D. Mathews and Ptnrs., 3 Ebury St, S.W.1.

Whitby. Leeds Regional Hospital Board, Harrogate, plan extensions, Eskdale Hospital.

Wickford. Leslie and Co. Ltd., Peel St, W.8, contractors for Heron Group six small factories.

Workshop. Sandy and Norris, Newport Rd, Stafford, architects for proposed £70,000 R.C. secondary modern school, Netherton Rd.

York. Seven-storey offices/showrooms, Piccadilly, proposed by Hammonds United Breweries Ltd., Bradford.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons Ltd., 116 Chancery La, W.C.2.

A.C. Industries Ltd., 15 Victoria St, Camberley, Surrey. To take over the business of electrical and electronic engineers carried on at Camberley as "A.C. Industries," etc. Nom. cap.: £5,000. Dirs.: Ralph E. C. Lord and John D. Budd.

G. F. Dinan Ltd. Electrical engineers, general engineers, welding experts, etc. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: Dorothy M. Graeme and Paul G. Graeme, 61 Fairview Ave, Gillingham.

E.D. (Electrical) Ltd, 86 Cranbrook Rd, Ilford, Essex. Nom. cap.: £1,000. Dirs.: to be appointed by subs. Subs.: Albert C. Sanderson and John P. Sanderson.

Electrical Services (Coxley) Ltd., Wayside, Coxley, nr. Wells, Som. To take over the business of electricians carried on at Coxley by D. B. E. and Christine Duke, etc. Nom. cap.: £500. Dirs.: David B. E. Duke and Christine Duke.

Electric Washer Repair Co. Ltd. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: Michael Kempley, Peveril, Lee Lane East, Horsforth; and Chas. S. Cockcroft, 25 Sholebroke Terr, Leeds 7.

Electrotech Instruments Ltd., 183 Ashley Rd, Parkstone, Poole. Manufacturers of and dealers in electronic equipment, etc. Nom. cap.: £100. Dirs.: John L. Hooper and Trevor Holdsworth.

W. Glass (Housewares) Ltd., 21 Red Lion St, W.C.1. Manufacturers of and dealers in electrical and other equipment, etc. Nom. cap.: £100. Dirs.: Wm. Glass and Stanley Prashker.

Graham's (Derby) Ltd., 123-5 Pear Tree Rd, Derby. Manufacturers of and dealers in radio, electrical and mechanical apparatus, etc. Nom. cap.: £15,000. Dirs.: Wm. T. Graham and Mrs Margaret E. Graham.

H. and W. Green Ltd., 78a Meadow Rd, Leeds 11. To take over business of radio, television and electrical engineers carried on at Meadow Rd, Leeds, and Dewsbury Rd, Leeds, as "H. and W. Green," etc. Nom. cap.: £5,000. Dirs.: Harry Green and Mrs Mary Green.

D. P. Gregory Ltd., 3 Baker St, Birmingham 11. Manufacturers of and dealers in electrical and other equipment, etc. Nom. cap.: £100. Dirs.: Derek P. Gregory and Roy D. Pickering.

H. Horne Electrical Ltd., 36 Pinewood Rd, Sidcup, Kent. Nom. cap.: £100. Dirs.: Harold Horne and Alfred E. Turner.

Hygro-Robot Ltd., 1 Fitzroy Sq, W.1. Manufacturers of and dealers in air humidifiers, etc. Nom. cap.: £1,000. Dirs.: John A. F. Seddon and June M. Treister.

Jayroy Electrical Co. Ltd., 30 Aynscombe Angle, Orpington, Kent. Nom. cap.: £100. Dirs.: Jas. E. Harley, John E. Barratt and R. W. E. Barratt.

G. W. Limer and Co. Ltd., 30 Regent St, Nottingham. Electrical contractors, electricians, etc. Nom. cap.: £100. Dirs.: George W. Limer and Mrs Doreen A. Limer.

Magnetic Tracks Ltd., 6 Laurence Pountney Hill, E.C.4. Manufacturers of and dealers in radio, electrical and mechanical apparatus, tape recording machines, etc. Nom. cap.: £100. Dirs.: Thomas Neville-Hadley and Manfield A. Broch.

Main Contracts Ltd., 181-3 Trafalgar Rd, S.E.10. Electricians, etc. Nom. cap.: £100. Dirs.: Jas. J. Breakwell and Margaret Breakwell.

H. F. Marshall (Electric) Ltd., Electric Hse, Hardon Rd, Leamore, Walsall, Staffs. Nom. cap.: £2,000. Dirs.: Harold F. Marshall and Mrs Lilian R. Marshall.

Miniature Parts Ltd., 34-40 Ludgate Hill, E.C.4. Manufacturers of small components for the engineering, electronic and electrical industries, etc. Nom. cap.: £1,000. Dirs.: Henry H. Duckworth and Alex P. Besson.

Onocordo Ltd., 64a Station Bldgs, 115 Moorgate, E.C.2. Manufacturers of electrical equipment, etc. Nom. cap.: £100. Dirs.: Frank W. Holland and Leslie E. C. Hughes.

Otehall Ltd., Otehall Wks, Station Rd, Burgess Hill, Sussex. To take over the business of manufacturers of precision switches carried on at Burgess Hill as "Otehall and Co.", etc. Nom. cap.: £10,000. Dirs.: Donald C. Beer, Brian Beer and Ronald A. Langridge.

Overend Electrics Ltd., 5 Albemarle St, W.1. Manufacturers of and dealers in dynamos, refrigerators, cookers, etc. Nom. cap.: £1,000. Dirs.: John M. Overend and Ronald L. M. Overend.

Paridela Electrics Ltd., Imperial Hse, Kingsway, W.C.2. Nom. cap.: £100. Dirs.: to be appointed by subs.: Subs.: Shirley Hart and Averill Hart.

Ringway Lighting Ltd., 215 High St, Hounslow, Middx. Electrical engineers, etc. Nom. cap.: £1,000. Dirs.: David Bailey and Rosemary S. Bailey.

Vanguard Electrics Ltd., Vanguard Wks, 585 Uxbridge Rd, Hayes, Middx. Nom. cap.: £100. Dirs.: Frank Arnold and Mrs Marjorie V. Arnold.

Washerwise Ltd., 42 Albany Rd, Cardiff. Dealers in domestic appliances, washing machines, etc. Nom. cap.: £100. Dirs.: Glyn Jones and Mrs Doris W. Jones.

Winders (Electrical) Ltd., 205 Manor Rd, Brimington, Chesterfield, Derbys. Nom. cap.: £1,100. Dirs.: John Tonge, Harry Jervis and Gordon Whittaker.

Worth and Aviss Ltd., 227 Holland Park Ave, W.11. Electricians, etc. Nom. cap.: £100. Dirs.: Wm. E. Charlesworth and Sydney F. Aviss.

MEETINGS TO NOTE

MONDAY, 12 JUNE

BRITISH ELECTRIC POWER CONVENTION at Eastbourne until 15 June.

TUESDAY, 13 JUNE

A.S.E.E. (Chester and District). "Circuitry and Applications of Transistors." Westminster Hotel, City Rd. 7.45 p.m.

WEDNESDAY, 14 JUNE

INSTITUTION OF PRODUCTION ENGRS. Viscount Nuffield paper, "Some Aspects of Engineering Progress." Sir Willis Jackson. Large Lecture Theatre, Eng. Faculty, Bristol University 6.30 p.m.

ASSOC. OF MANAGERIAL ELECTRICAL EXECUTIVE. A.G.M. Lecture Hall, Winter Gdns, Devonshire Pk, Eastbourne. 5 p.m.

WEDNESDAY, 21 JUNE

INTERNATIONAL PLASTICS EXHIBITION AND CONVENTION at Olympia until 25 June.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Accutron. 812,144. Class 9. Apparatus, etc. Bulova Watch Co. Ltd., 372 Bay St, Toronto, Ontario, Canada.

Axem. 804,917. Class 9. Apparatus, etc. Normacem, 37 rue du Rocher, Paris 8e, France.

Cossor Instruments in design. B805,423. Class 9. Cathode ray tubes, etc. A. C. Cossor Ltd., Cossor Hse, Highbury Grove, N.5.

Dinset. 803,774. Class 9. Electronic apparatus for use with machine tools for automatically controlling work positioning. James Scott and Co. (Electrical Engrs.) Ltd., 68 Brockville St, Carntyne Industrial Estate, Glasgow E.2.

Kestrel in design. 816,322. Class 9. Apparatus, etc. 816,323. Class 11. Lampholders, lighting fittings and radiators. Kestrel Eng. Co. Ltd., 222 Soho Hill, Handsworth, Birmingham 19.

Numeritrol. 813,057. Class 9. Apparatus, etc. A.E.I. Ltd., 33 Grosvenor Pl, S.W.1.

Polymatic. 811,994. Class 11. Fans, refrigerators, radiators, etc. Polymatic Domestic Appliances Ltd., Cater Bldgs, Cater St, Bradford 1.

Telematic. 795,545. Class 9. Control apparatus, etc. Drayton Controls Ltd., Horton La, West Drayton.

Tung-sol. 815,405. Class 9. Transistors, rectifiers, etc. Tungsol Electric Inc., 1 Sumner Ave, Newark 4, New Jersey, U.S.A.

Unibloc. 817,048. Class 9. Apparatus, etc. R. B. Pullin and Co. Ltd., Phoenix Wks, Gt. West Rd, Brentford, Middx.

Zeromatic. 812,131. Class 11. Refrigerators. Simplex Electric Co. Ltd., Creda Wks, Grindley La, Blythe Bridge, Staffs.

KEEPALITE PACKS MORE IN THE SAME SPACE

Keepalite, the Chloride Company's automatic emergency lighting system, is now equipped exclusively with the new Chloride Planté cell which occupies only half the space previously needed by cells of the Planté type of equivalent capacity. Keepalite thus adds this important advantage to the many virtues that have made it the most trusted and widely used emergency lighting system in Great Britain. Despite its small size and light weight, the new cell is extremely robust and has all the great length of life associated with the Planté type of construction. As always, the advisory service of the Company's electrical engineers is at the call of electrical contractors and engineers who are interested in emergency lighting installation.

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CLASSIFIED ADVERTISEMENTS

TENDERS INVITED

CITY AND COUNTY OF BRISTOL
Cumberland Basin Bridges Scheme
MECHANICAL AND ELECTRICAL EQUIPMENT FOR SWING BRIDGE

AN invitation is extended to suitably experienced manufacturers to apply for inclusion in a selected list of firms who will be asked to tender for the design, manufacture, erection and commissioning of the following equipment:

Operating gear for a centre bearing swing bridge of estimated moving weight of 900 tons, comprising electrical or electro-hydraulic drive with associated mechanical equipment and electrical control gear. Bridge jacking, wedging and locking mechanisms, road safety gates and allied control console and interlocks.

The successful tenderer will be a nominated sub-contractor to the eventual main bridge contractor and the contract will be dependent upon the receipt of grant authorisation for the scheme from the Ministry of Transport.

Applications, together with supporting evidence of similar plant which has been erected and put into operation, should reach the City Engineer and Planning Officer, Cabot Hse, Deanery Rd, Bristol 1, by 12 noon, 1 July. (B 125)

CLOWNE PARISH COUNCIL
Street Lighting

TENDERS are invited for the installation of Class "A" lighting on routes A616 and A618 in the parish of Clowne, near Chesterfield, consisting of the provision and erection of 115 concrete columns together with 115 sodium lighting units. Specifications and bills of quantities may be obtained from me on receipt of a deposit of £2 2s, which will be returnable if a bona fide tender is made.

Tenders to be submitted to me in plain sealed envelopes marked "Class 'A' Lighting" by noon on Monday, 3 July, 1961.

L. HOWE,
Clerk to the Council.

4 Harlesthorpe Ave,
Clowne, Nr. Chesterfield. (B 99)

COUNTY COUNCIL OF MIDDLESEX
Staines By-Pass
Street Lighting—Wraysbury Roundabout

TENDERS are invited from experienced Contractors for the SUPPLY, DELIVERY and ERECTION of 14 STEEL STREET LIGHTING COLUMNS together with Mercury Fluorescent Lamps, Wiring, Lanterns and auxiliary gear.

Contract documents can be obtained and drawings examined at the office of the County Engineer and Surveyor, Middlesex Hse, 20 Vauxhall Bridge Rd, London S.W.1, upon deposit of £5, returnable on submission of a bona fide tender.

Tenders are to be returned to the undersigned in the envelope provided by not later than noon on Wednesday, 28 June, 1961.

The County Council does not bind itself to accept the lowest or any Tender.

KENNETH GOODACRE,
Clerk of the County Council.

The Guildhall,
Westminster,
London S.W.1. (B 87)

CITY OF MANCHESTER—HOUSING COMMITTEE

TENDERS invited (returnable noon, 19 June, 1961) for Electrical Installations at the following:

Contract 301. Councillor La, Cheadle. 353 dwellings.

Particulars and documents available from the Director of Housing, Town Hall, Manchester 2. (B 124)

APPOINTMENTS VACANT

CENTRAL ELECTRICITY GENERATING BOARD
East Midlands Division

SHIFT CHARGE ENGINEER
WARWICK POWER STATION
Vacancy No. 115/61.

APPLICATIONS are invited from qualified engineers for the position of Shift Charge Engineer at Warwick Power Station, Emscote, Warwick.

Applicants should have had experience in the operation of steam turbine and boiler plant.

Salary will be in accordance with Class E, Grade 7 (£965/£1,090 per annum), of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 16 June, 1961.

ASSISTANT SHIFT CHARGE ENGINEER
STAYTHORPE "A" POWER STATION
Vacancy No. 124/61.

Applications are invited from qualified engineers for the position of Assistant Shift Charge Engineer at Staythorpe "A" Power Station, nr. Newark, Notts.

Applicants should have received a sound technical training and have had experience in a modern power station. Preference will be given to candidates who possess the Higher National Certificate, or its equivalent.

Salary will be in accordance with Class K, Grade 8 (£1,275/£1,410 per annum), of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 16 June, 1961.

ASSSISTANT ENGINEERS (CONTROL ROOM)
LEICESTER POWER STATION
Vacancy No. 125/61.

Applications are invited for the positions of Assistant Engineers (Control Room) at Leicester Power Station, Rawdykes Rd, Leicester.

Candidates for this post should be suitably qualified and have had experience in the control room.

Salary will be in accordance with Class G, Grade 13 (£715/£805 per annum), of the National Joint Board Agreement, plus £90 per annum allowance whilst engaged on shift duties.

Closing date for receipt of applications. 16 June, 1961.

GENERAL ASSISTANT ENGINEERS
DRAKELOW "A" AND "B" POWER STATIONS
Vacancy No. 126/61.

Applications are invited for the positions of General Assistant Engineers at Drakelow "A" and "B" Power Stations, near Burton-on-Trent.

Preference will be given to candidates who hold the Higher National Certificate

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or who are at present pursuing a course of study with the object of obtaining this or a similar qualification.

Salary will be in accordance with Class M, Grade 16 (£825/£940 per annum), of the National Joint Board Agreement.

Closing date for receipt of applications: 16 June, 1961.

STATION SHIFT CONTROL ENGINEER
COVENTRY POWER STATION
Vacancy No. 127/61.

Applications are invited for the position of Station Shift Control Engineer at Coventry Power Station, Alderman's Green, Coventry.

Applicants should possess a sound technical training and have practical experience in the control of steam generating plant and the operation of switchgear.

Salary will be in accordance with Class G, Grade 10 (£890/£1015 per annum), of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 16 June, 1961.

GENERAL ASSISTANT ENGINEER
CASTLE DONINGTON POWER STATION
Vacancy No. 128/61.

Applications are invited for the position of General Assistant Engineer at Castle Donington Power Station, Castle Donington, near Derby.

Duties will include operation, planning and general plant investigation work.

Preference will be given to applicants holding or taking a Higher National Certificate in Electrical or Mechanical Engineering.

The salary will be within Class L, Grade 15 (£825/£940 per annum), of the National Joint Board Agreement.

Closing date for receipt of applications: 23 June, 1961.

GENERAL ASSISTANT ENGINEER
HIGH MARNHAM POWER STATION
Vacancy No. 131/61.

Applications are invited for the position of General Assistant Engineer at High Marnham Power Station, near Newark, Notts.

Preference will be given to candidates who hold the Higher National Certificate or who are at present pursuing a course of study with the object of obtaining this or a similar qualification.

Salary will be in accordance with Class N, Grade 17 (£825/£940 per annum), of the National Joint Board Agreement.

Closing date for receipt of applications: 23 June, 1961.

These appointments are pensionable within the terms and conditions of the Electricity Supply (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT which may be obtained from the Station Superintendent concerned and returned to him by the specified date.

O. S. WOODS,
Divisional Controller.
(B 115)

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD
Dundee Area

CABLE JOINTER (FORFAR)

APPLICANTS should be experienced in the jointing of all types of M.V. cables, service terminations, transformer terminations, etc. Preference will be given to plumber jointers with H.V. training and experience.

Wages according to the N.J.I.C. Agreement are:

Jointer E.H.T.: 5s 6½d per hour; Jointer: 5s 4½d per hour. Both rates are for a five-day, 42-hour week.

A Superannuation Scheme is applicable to the post.

Applications should be made on the standard application form obtainable from the Area Manager, North of Scotland Hydro-Electric Board, 7 Dudhope Crescent Rd, Dundee, and returned not later than 1 July, 1961. (B 119)

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 46s. per inch, and all other classified advertisements at 3s. 6d. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

CENTRAL ELECTRICITY GENERATING BOARD
South Eastern Region
Regional Research and Development Department

THE following vacancies exist in the above Department, located at West Farm Pl, Chalk La, Cockfosters, Herts. The salary will be within the ranges described, depending on experience, in accordance with N.J.B. Agreement, Schedule B, Class CX.

Thermodynamics and Mechanical Branch

FUEL TECHNOLOGIST
Vacancy No. S.E.18/61.

Grade 3/4/5, £1,435/£2,145 per annum, including London Allowance.

The successful candidate will be required to co-ordinate investigational work being carried out at oil firing stations and to organise testing of running plant.

Candidates should have a degree, Higher National Certificate, or Associate Membership of the Institute of Fuel. Experience in the operation of power station oil fired boilers and a good knowledge of both the engineering and chemical aspects of oil firing would be an advantage.

ASSISTANT
Vacancy No. S.E.19/61.

Grade 6/7/8, £1,155/£1780 per annum, including London Allowance.

There is a vacancy for an Assistant in the Mechanical Branch whose duties will be to assist in planning and carrying out investigational work at power stations and in a laboratory.

Applicants should have a degree or Higher National Certificate, and experience in power station operation and/or testing or investigational experience in modern plant.

GENERAL ASSISTANT
Vacancy No. S.E.20/61.

General Assistant Grades 12-19, £665/£1,215 per annum, including London Allowance.

There is a vacancy for a General Assistant in the Mechanical Branch whose duties will be to assist in carrying out investigational work at power stations and in a laboratory.

Applicants should have a degree or Higher National Certificate and some experience of power plant. Opportunity will be given to obtain further experience with a variety of projects, and there are good promotion prospects.

Applications, giving Vacancy Number, age, qualifications, experience, etc., to the Regional Secretary, Central Electricity Generating Board, South Eastern Regional Headquarters, Ergon Hse, Horseferry Rd, S.W.1, to be received by 20 June, 1961. (B 97)

CENTRAL ELECTRICITY GENERATING BOARD
South Eastern Region
North Thames Division

APPLICATIONS are invited for the following appointments in the System Operation Department, North Thames Grid Control Centre, Redbourn, near St. Albans, Herts.

FOURTH ASSISTANT ENGINEERS

Salary: N.J.B., Class BX, Grades 9-11, within the range of Scales 8-10, £855/£1,325 per annum.

The commencing salary will be within the above range at a point commensurate with qualifications and experience. The minimum technical qualification required is the Higher National Certificate in Electrical Engineering.

Some generating station and/or transmission/technical experience is desirable. The duties are on day work and are of a general technical and statistical nature, but applicants must be prepared ultimately to undertake shift duties in the Grid Control Room.

Forms of Application (AE.6/ACT) may be obtained from the Board's Headquarters, or from any Divisional Office of the Board, and should be addressed to the Personnel Officer, Central Electricity Generating Board, North Thames Division, West Farm Pl, Chalk La, Cockfosters, Barnet, Herts, to arrive not later than 17 June, 1961, quoting Reference S.V. No. 1398. (B 83)

AIR MINISTRY

ENGINEERING DESIGNER DRAUGHTSMEN REQUIRED IN LONDON

SALARY (inner London scale) Grade III, £658/£1,048 (£866 at age 25)—starting salary depends on age, quals. and exp.

Electrical Engineering Designer Draughtsmen experienced in preparation of schemes for illumination and electrical equipment of buildings or schemes for H.V. and M.V. electrical distribution (Grade III).

Candidates should have served a recognised apprenticeship or have had equiv. training and also adequate practical exp. Possession of recognised technical qualn. an advantage—financial assistance and time off may be allowed for recognised courses of study for technical quals. Five-day week with 18 days' paid leave p.a. initially. Promotion and pension prospects. Some overseas tours with special allowances in addition to salary.

Applicants, who must be natural born British subjects should write (quoting King's Cross A/N 803) to Air Ministry, W.G.d, Lacon Hse, Theobalds Rd, London W.C.1, or to any Employment Exchange, giving age, details of training, quals. and full particulars of former posts held. Candidates selected will normally be interviewed in London and certain expenses reimbursed. Only candidates selected for interview will be notified. (B 24)

FIJI

ENGINEER

POSTS AND TELEGRAPHS DEPARTMENT

DUTIES: To be responsible for organisation and execution of telecommunications work in Headquarters and districts and to initiate training of local staff.

Qualifications: Candidates (30-50 years) must possess Corporate or Graduate Membership of the Institution of Electrical Engineers or a degree in Electrical Engineering and must have at least five years' experience in execution and maintenance of a telecommunications system with good working knowledge of modern telecommunication techniques including 12-channel and super-group carrier systems.

Terms of Appointment: Three-year contract. Salary in scale £900/£1,809, according to experience and military service. Gratuity. Disturbance allowance. Free passages.

Write Director of Recruitment, Colonial Office, London S.W.1, quoting BCD 108/49/07/D10, giving full names, age, qualifications and experience. (B 100)

UGANDA GOVERNMENT
Public Works Department

INSPECTOR OF WORKS (ELECTRICAL)

REQUIRED. Appointment on contract for one tour of 21-36 months in first instance. Salary according to age and experience in scale (including Inducement Pay) rising to £1,671 a year. Gratuity 25% of total salary drawn. Outfit allowance £30 payable. Free passages. Liberal leave on full salary.

Candidates, 29-40 years of age, must possess O.N.C. (Electrical) or equivalent qualification, have served a full apprenticeship and had subsequent experience in maintenance of industrial electrical equipment and large installations. They must be fully conversant with U.K. Home Office Electricity Rules, Electricity Regulations under the Factories' Act and those of the Electrical Commissioners.

Apply to CROWN AGENTS, 4 Millbank, London, S.W.1, for application form and further particulars, stating age, name, brief details of qualifications and experience and quoting reference M2A/50987/EE. (B 108)

CENTRAL ELECTRICITY GENERATING BOARD
Midlands Project Group

GENERAL ASSISTANT ENGINEERS (DRAWING OFFICE)—CIVIL

APPLICATIONS are invited for appointments as General Assistant Engineers (Drawing Office) (Civil), in the Midlands Project Group's Drawing Office, at Bournville, Birmingham.

Candidates should possess a sound practical and technical training and be working towards a suitable professional qualification. The salary will be within Grade 15, Scale 5, £650/£940 per annum, in accordance with the National Joint Board Agreement.

Applications should be made on standard form AE.6, available from the Administrative Officer, Midlands Project Group, P.O. Box 314, Birmingham 30, and should be returned to him not later than 19 June, 1961.

Envelopes should be marked "Confidential" quoting Staff Vacancy No. MPG.39/61. (B 78)

LONDON ELECTRICITY BOARD

ASSISTANT DISTRIBUTION ENGINEERS AND GENERAL ASSISTANT ENGINEER

APPLICATIONS are invited for the under-noted positions in the Board's Essex Suburban District at 497-9 Ley St, Ilford, Essex.

Arising from special circumstances, rented housing accommodation will be available for two of the successful candidates.

ASSISTANT DISTRIBUTION ENGINEER
(REF.: PER/V/3298/T)

Grade 11 (£940/£1,065 p.a. incl.).

ASSISTANT DISTRIBUTION ENGINEER
(REF.: PER/V/3205/T)

Grade 12 (£875/£990 p.a. incl.).

These posts are graded under Schedule A, Class H, of the National Joint Board Agreement.

Applicants should have a sound technical education to the standard of the Higher National Certificate and possess practical experience of engineering work associated with the organisation of a District distribution department.

GENERAL ASSISTANT ENGINEER
(REF.: PER/V/3089/T)

Grade 15 (£695/£920 p.a. incl.).

This post is graded under Schedule B, Class BX, of the National Joint Board Agreement.

Applicants should have a sound technical education to the standard of the Higher National Certificate, and have completed a recognised period of training in the Electricity Industry, or have equivalent experience.

Applications, stating age, qualifications and experience and quoting the appropriate ref. number, should be sent to the Manager at the above address, within 14 days of the publication date of this notice. (B 81)

CENTRAL ELECTRICITY GENERATING BOARD

APPLICATIONS are invited for the following superannuable post. Conditions of service in accordance with N.J.B. Agreement, Schedule B. Salary includes London Allowance.

FOURTH ASSISTANT ENGINEERS (THREE)
ELECTRICAL DEPARTMENT
(TECHNICAL SECTION)
(COMMISSIONING AND PROTECTION)
GENERATION HOUSE
Vacancy No. 61/335.

Applications are invited from engineers having a sound technical training with qualifications leading to Corporate Membership of the I.E.E. Some knowledge of the design and testing of protective equipment would be an advantage. Experience in the manufacture and/or testing of electrical equipment in the Supply Industry is desirable. Salary: Grade 11, £905/£1,215 per annum.

Applications, quoting vacancy number, may be made to (or on form from) Personnel Department, Central Electricity Generating Board, P.O. Box No. 136, Generation Hse, Great Portland St, W.1, to be received not later than 26 June, 1961. (B 98)

ELECTRICITY BOARD FOR NORTHERN IRELAND

APPLICATIONS are invited for the appointment at the Board's Head Office, Danesfort, 120 Malone Rd, Belfast 9, of

CHIEF TECHNICAL ASSISTANT

directly responsible to the General Manager and Chief Engineer.

Candidates, who should not be more than 45 years of age, must have a University Degree in Electrical Engineering, be a Corporate Member of the Institution of Electrical Engineers, have had a sound enginering training, preferably in the works of a manufacturer of steam turbine and electrical equipment, and good practical experience in the installation and operation of mechanical and electrical equipment on an interconnected electricity supply system with large modern steam power plant, E.H.T. transmission and L.T. distribution. They should also be familiar with, and have had experience in, the planning, development and technical aspects of such a system.

The salary will be in accordance with Scale No. 18, Grade 1, Class K, of the Northern Ireland Electricity Supply Industry Joint Board Schedule, viz., £2,050 plus 3 x £35 and 2 x £40—£2,235 per annum.

Membership of the Electricity Board (Northern Ireland) Superannuation Fund will be a condition of the appointment.

Applications, which should set out concisely age, education, degrees and other qualifications and details of practical experience, accompanied where possible by copies of testimonials, should be sent so as to reach the Secretary of the Board at the above address not later than Monday, 3 July. Envelopes should be marked "Confidential." (B 130)

SOUTHERN ELECTRICITY BOARD

ASSISTANT ENGINEER
(SUBSTATION MAINTENANCE)

BOURNEMOUTH District of No. 4 (Bournemouth) Sub-Area. Salary: N.J.B. Class J, Grade 9 (£1,115/£1,245 per annum). N.J.B. Conditions of Service.

The duties of the post will be to assist with the maintenance of plant and equipment at outdoor and indoor substations on both urban and rural systems and to undertake standby duties. Candidates should have experience of the commissioning and maintenance of plant and equipment up to, and including 33 kV. The possession of suitable technical qualifications will be an advantage.

Applications on forms obtainable from the Sub-Area Secretary, 1 Priory Rd, Bournemouth, Hants, and returned to him, quoting Z.1359, not later than 19 June, 1961.

INSTALLATION ASSISTANT

Swindon District of No. 2 (Newbury) Sub-Area. Salary: N.J.B. Class G, Grade 11 (£825/£940 per annum). N.J.B. Conditions of Service.

Applicants should have had experience in the preparation of specifications and estimates for all types of electrical wiring installations. They should be competent to supervise electricians and organise the allocation of work.

Applications on forms obtainable from the Sub-Area Secretary, 7 Oxford Rd, Newbury, Berks, and returned to him, quoting Z.1334, not later than 19 June, 1961.

GENERAL ASSISTANT ENGINEER

Construction Department of No. 2 (Newbury) Sub-Area, located at Newbury (East Sub-Section). Salary: N.J.B. Class M, Grade 18 (£715/£805 per annum). N.J.B. Conditions of Service.

The duties of the post will be to assist with the installation and erection of plant, equipment and overhead lines, the laying of cables and other constructional work on all distribution systems up to and including 33 kV.

Applications on forms obtainable from the Sub-Area Secretary, 7 Oxford Rd, Newbury, Berks, and returned to him, quoting Z.1317, not later than 19 June, 1961.

DEMONSTRATOR

Portsmouth District of No. 3 (Portsmouth) Sub-Area. Salary: N.J.C. Grade 1 (£600/£700 per annum). N.J.C. Conditions of Service.

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Applicants should be qualified to advise generally on the utilisation of electric domestic appliances, to give public demonstrations of apparatus and to assist in showroom duties. The possession of an E.A.W. Certificate or equivalent Domestic Science qualification would be an advantage.

Applications on forms obtainable from the Sub-Area Secretary, Lower Drayton La, Cosham, Portsmouth, and returned to him, quoting Z.1357, not later than 19 June, 1961.

The successful candidates for the above appointments will be required to contribute to the Electricity Supply (Staff) Superannuation Scheme, if eligible.

FITTER (ELECTRICAL)

Basingstoke District of No. 3 (Portsmouth) Sub-Area. The rate of pay will be 66.75d per hour, with N.J.I.C. Conditions of Service.

Candidates should have experience in the work of fitting and erecting high-voltage O.C.B.s, isolators and other substation equipment.

Applications on forms obtainable from the District Manager, Manor Hse, Winchester Rd, Basingstoke, and returned to him, quoting Z.1223, not later than 19 June, 1961. (B 131)

THE EAST MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited from suitably qualified and experienced persons for the following appointments. Applicants should state age, qualifications, experience, etc., and quote the appropriate Vacancy Number.

Ilkeston and North Derbyshire Sub-Area:

DEMONSTRATOR
CHESTERFIELD DISTRICT
Vacancy No. 62/61.

Salary: N.J.C. Grade 1, £600 x £25—£700 per annum.

Applicants must be over 21 years of age and should hold the E.A.W. Electrical Housecraft Certificate and be experienced in general Service Centre duties and capable of conducting demonstrations and advising consumers on the selection and use of electrical appliances, both at Service Centres and on consumers' premises.

Applications, giving details of education, training and experience, should be forwarded to the Manager, Chesterfield District, 172 Chatsworth Rd, Chesterfield, Derbyshire, by 23 June, 1961.

Derby and Burton Sub-Area:

DISTRICT COMMERCIAL ENGINEER
UTTOXETER DISTRICT
Vacancy No. 63/61.

Salary: N.J.B. Class D, Grade 3, £1,190/£1,325 per annum, with progression to Grade 2.

It is expected that the Uttoxeter District will be reclassified to Class E from 1 April, 1962.

The District will operate as a double-headed organisation and the successful candidate will be responsible for all the district commercial activities.

The duties will include negotiations for the supply of electricity to industrial, commercial, and agricultural consumers, application of the Board's tariffs, advice on the design of consumers' installations, including restricted-hour loads, arranging exhibitions and demonstrations, and the control of service centres and general consumer service.

Candidates should have a sound technical and engineering training and should be thoroughly conversant with all matters connected with the commercial functions and the organisation in an urban and rural district, including the supervision of staff.

Corporate Membership of the Institution of Electrical Engineers will be an advantage.

The successful candidate will be required to live within the district and ability to drive a car is essential.

Applications should be forwarded to the Manager, Derby and Burton Sub-Area, Electricity Offices, Irongate, Derby, in an envelope endorsed "District Commercial Engineer, Uttoxeter," by 23 June, 1961. (B 111)

SOUTH WESTERN ELECTRICITY BOARD

GENERAL ASSISTANT ENGINEER
(SURVEY AND DRAWING OFFICE)
CENTRAL CONSTRUCTION DEPARTMENT
TAUNTON

SALARY according to Class AX, Grade 12, Salary Scale 6, £780/£1,015 per annum, of the N.J.B. Agreement.

Duties include the selection, survey and profiling of overhead line and underground cable routes and substation sites; also the preparation of maps and schedules of materials. The successful candidate may also be required to assist in the Drawing Office as needed.

Candidates must have had experience in the use of a theodolite and dumpy level and the possession of an appropriate qualification and the ability to drive a car would be an advantage.

Applicants for this post should be prepared to be mobile throughout the Board's area and will be based at Taunton or at a convenient alternative centre. Travelling and subsistence allowances in accordance with the N.J.B. Agreement will be paid when working away from base.

Applications to be made on Standard Form AE6/ACT, OBTAINABLE BY POST-CARD ONLY from the Establishments Officer, South Western Electricity Board, Electricity Hse, Colston Ave, Bristol 1. Closing date for receipt of completed applications is 24 June, 1961. (B 110)

LONDON ELECTRICITY BOARD

ASSISTANT BUILDING SUPERINTENDENT
NORTH WESTERN AREA

APPLICATIONS are invited for the above position in the Building Section, Construction Branch, of the Chief Engineer's Department at Chelsea.

The successful applicant will be required to assist the Building Superintendent in controlling building and maintenance work. He will also be required to take charge of building work carried out by direct labour and to supervise contracts executed by contractors.

Candidates should have had a good general experience within the building industry and be able to assist in preparing estimates, schedules of quantities, and the ordering of materials. They should be acquainted with building specifications and be able to work from architectural drawings, and also have a knowledge of building bye-laws and various Acts of Parliament for the building industry.

The post is graded under Schedule B of the National Joint Board Agreement as Grade 8, Class BX, and the commencing salary will be in the range of £1,155/£1,460 per annum, inclusive of London Allowance.

Application form obtainable from the Personnel Officer, 46 New Broad St, London E.C.2, to be returned completed within 14 days of the publication date of this notice Please quote ref.: PER/V/3277/T. (B 82)

SOUTH OF SCOTLAND ELECTRICITY BOARD

APPLICATIONS are invited for a superannuable position as a

SENIOR ASSISTANT ENGINEER

in the Planning and Economics Section of the Chief Commercial Officer's Department.

Applicants should have had experience in the generation and distribution sides of an electricity supply organisation and should possess a good knowledge of statistical theory, costing, supply economics and tariff design. The duties will include commercial studies on generation economics, supervision of programmes of utilisation research and the statistical analyses of the data, and the design of bulk supply and retail tariffs.

Corporate membership of either the Institution of Electrical Engineers or the Institution of Mechanical Engineers is desirable.

Salary: N.J.B. Class BX, Grade 3, £1,570/£1,950 per annum.

Applications, quoting reference C8/61, should be submitted on the standard form to the Secretary, South of Scotland Electricity Board, Inverlair Ave, Glasgow S.4, not later than 23 June, 1961. (B 113)

YORKSHIRE ELECTRICITY BOARD

No. 3 (Sheffield) Sub-Area

ASSISTANT ENGINEER (CONTRACTING)

APPLICANTS should be fully experienced in the preparation of specifications, estimating and tendering for all types of electrical installations, be able to supervise and control labour and be capable of negotiating with principals.

Salary: N.J.B. Class L, Grade 8 (Scale 12), £1,350/£1,500 per annum.

Applications, together with the names of two referees, should be sent to the Manager, No. 3 (Sheffield) Sub-Area, Yorkshire Electricity Board, Commercial St, Sheffield 1, not later than 23 June, 1961.

No. 1 (Bradford) Sub-Area

BRADFORD DISTRICT
THIRD ASSISTANT DISTRICT ENGINEER

Applicants should have substantial experience in construction, operation and maintenance of high-voltage systems, underground cables and overhead lines, substations and medium and low-voltage networks, preferably including direct current systems.

Candidates must be prepared to reside within the District and undertake standby duties if required.

Salary: N.J.B. Class K, Grade 9 (Scale 10), £1,190/£1,325 per annum.

Applications, together with the names of two referees, should be sent to the Manager, No. 1 (Bradford) Sub-Area, Yorkshire Electricity Board, 45/53 Sunbridge Rd, Bradford 1, not later than 23 June, 1961.

No. 2 (Huddersfield) Sub-Area

THIRD ASSISTANT ENGINEER
(DRAUGHTSMAN)

A Section Leader is required for work associated with design, layout and construction of substations operating at voltages up to and including 66 kV. Applicants must be capable of supervising other draughtsmen, be conversant with the theory and design of electrical plant and be competent in the preparation of plant layout drawings and wiring diagrams.

Salary: N.J.B. Class L, Grade 10 (Scale 10), £1,190/£1,325 per annum.

Applications, together with the names of two referees, should be sent to the Manager, No. 2 (Huddersfield) Sub-Area, Yorkshire Electricity Board, Market St, Huddersfield, not later than 23 June, 1961. (B 122)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

ASSISTANT CONSUMERS' ENGINEER

REQUIRED in the Northwich District of the Board's No. 2 Sub-Area. Salary within range £625/£700 per annum (N.J.B. F.14).

Duties will include estimating for contracting work, and advising consumers on matters relating to electricity supply and the utilisation of electrical equipment. A technical qualification is desirable.

Appointment subject to medical examination. Pension Scheme.

Application forms obtainable from the Manager, No. 2 Sub-Area, Sandiway Hse, Northwich, Cheshire. Closing date: 23 June, 1961. (B 121)

A leading Midlands manufacturer of electric wiring accessories seeks a SENIOR DESIGNER having specialised experience in this field, for which an appropriate salary will be paid. Position offers adequate scope for initiative and originality under congenial working conditions with all usual benefits. Holiday arrangements will be honoured.

Replies will be treated with absolute confidence. Box No. 8325, Electrical Times.

(B 129)

ENGLISH ELECTRIC

COMMISSIONING AND OPERATION

OF

NUCLEAR POWER STATIONS

Applications are invited for appointments that have arisen due to expansion of a new team that has been formed to commission and supervise the initial operation of the world's first 500 MW nuclear power station. As training will be given in the nuclear field to successful applicants, this is an ideal opportunity for engineeers interested in this field to enter a department from which personnel will be promoted to form the basis of future teams.

Inquiries will be welcomed from men having Associate Membership of one of the major professional institutions. Experience in a conventional power station is desirable and would be an advantage.

These are permanent positions in an expanding organisation. The company operates a pension and life assurance scheme to which successful candidates will be eligible to enter after a probationary period.

Please write giving details of qualifications and experience to the Technical Staff Officer, Group Personnel Services, English Electric Co. Ltd., English Electric House, Strand, London W.C.2, quoting reference number ET1888L. (B 91)

SOUTH OF SCOTLAND ELECTRICITY BOARD

Glasgow Area

APPLICATIONS are invited for the following superannuable appointment:
SECOND ASSISTANT ENGINEER

Candidates for this post should be in possession of technical qualifications leading to Corporate Membership of the Institution of Electrical Engineers. The successful candidate will be responsible for all aspects of the work associated with the Consumers' Service Section of the Area Commercial Officer's Department. Duties would include the supervision of personnel dealing with restoration of supplies, delivery and collection of appliances, workshop practice and appliance repairs.

Salary: £1,440/£1,610 per annum, in accordance with Class L, Grade 7 (Scale 13), of the National Joint Board Salary Scale.

The successful candidate shall be required to reside within reasonable travelling distance of Area Headquarters.

Applications, quoting Reference No. GC/7/61, should be submitted on the standard application form which is obtainable from the Area Secretary, 75 Waterloo St, Glasgow C.2, and should be returned not later than Monday, 19 June, 1961. (B 80)

THE NORTH WESTERN ELECTRICITY BOARD

SENIOR ASSISTANT (SUPERANNUATION)
ACCOUNTANCY DEPARTMENT
AREA BOARD HEADQUARTERS

APPLICANTS should have a comprehensive knowledge and wide experience of superannuation matters.

Salary Scale: £1,020 x £30-£1,140 p.a. Grade 5. N.J.C. conditions.

Applications on forms to be obtained from the Secretary, The North Western Electricity Board, Cheetwood Rd, Manchester, 8, and returned to him by 19 June, 1961. (B 104)

ADMINISTRATIVE COUNTY OF LEICESTER

ASSISTANT ELECTRICAL ENGINEER
£960/£1,310

CANDIDATES must be Associate Members of the Institution of Electrical Engineers or be in possession of the Higher National Certificate and be experienced in the design of electrical installations for all types of buildings. Removal expenses and lodging allowance may be paid to a married man. Apply on form available from the County Architect, 123 London Rd, Leicester. (B 10)

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD

Northern Area

VACANCY FOR
FIRST ASSISTANT DISTRICT ENGINEER

APPLICATIONS are invited for the post of First Assistant District Engineer in the Lewis District.

The District Office is in Stornoway where the successful candidate is required to operate.

The District is predominantly rural, embracing the Islands in the Outer Hebrides, and the post provides work of an interesting and varied nature which at times necessitates travel by sea and air.

Applicants should have experience in the construction, operation and maintenance of H.V. and L.V. overhead and underground distribution networks, sub-station plant and ancillary apparatus.

Minimum technical qualifications: Ordinary National Certificate in Electrical Engineering.

Superannuation Scheme applicable.

Salary: N.J.B., Class C, Grade 5, £965/£1,090.

Application forms obtainable from Area Manager, Church St, Dingwall, should be returned completed by 14 June, 1961. (B 86)

AIR PRODUCTS LIMITED

ELECTRICAL ENGINEER

Our Company, which designs, manufactures, erects and operates TONNAGE OXYGEN PLANT, wishes to appoint a qualified engineer.

He should be conversant with the specification of H.T. switchgear, large drive motors and motor control equipment. He will be responsible to the Senior Electrical Engineer for drawing up specifications and system diagrams.

This post offers tremendous scope for a skilled engineer to gain further experience in the switchgear and motor fields. Holiday arrangements will be honoured.

Please apply to The Personnel Manager
49-50 Poland Street, London W.1

(B 102)

PLANNING for ELECTRICITY SUPPLY

ASSISTANT ENGINEERS are required in the System Planning Branch of the Planning Department of the

Central Electricity Generating Board

at HEADQUARTERS, LONDON S.E.1.

The System Planning Branch is responsible for the initiation and co-ordination of programmes of new generating plant and main transmission. The work of the branch includes statistical analysis of the growth of electricity demand and the preparation of estimating data for forward planning, study of the technical and economic considerations in the deployment of new generating capacity and in fashioning the pattern of power and energy movement, analysis of system performance to aid reliability in forward planning, and preparation and reporting to management of comprehensive plans for development of the power system as an entity.

Candidates should have an aptitude for clear and imaginative thinking, and the ability to express themselves clearly and concisely. Experience gained within a large interconnected electricity supply system would be an advantage but is not essential. Further advantages would be a knowledge of engineering economics or experience in the application of digital computing techniques to scientific problems. Technical qualifications at least equivalent to Graduate Membership of the Institution of Electrical Engineers are expected and a degree of a British University would be an advantage.

Salaries on scales within the range:

£930 - £1,890 p.a.,

according to duties and responsibilities.

Applications stating age, qualifications, experience, present position and salary to the Appointments Officer, 24-30 Holborn, London E.C.1, by 26 June. Envelopes should be marked "Confidential Ref. ET/247."

(B 85)

J. LYONS & CO. LTD.,

ELECTRICAL DRAWING OFFICE

require

Design Draughtsmen

experienced in preparing schemes for industrial electrical installations including Hotels, Restaurants and Factories.

Good prospects for applicants with initiative. Salary according to age and experience. 5-day week. Pension Fund. Social Club.

Please write or telephone for an interview with the Chief Draughtsman: Spike House, 161 Hammersmith Road, London W.6. Telephone: RIVerside 2040, Ext. 256. (B 84)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:

North Staffordshire Area

ENGINEERING DRAUGHTSMAN (GENERAL ASSISTANT ENGINEER) (AREA OFFICE)

Applicants should have experience in a large drawing office associated with: (a) the preparation of drawings in connection with substation and building construction, and the layout of H.V. and M.V. switchgear, cables, etc.; and (b) the preparation of mains records for an extensive H.V. and M.V. overhead and underground distribution system. Salary: £890/£1,015 per annum (N.J.B. Grade L.14).

Apply, by letter, within ten days, stating age, education, experience, qualifications and present position, to Mr C. C. Pimble, Area Manager, Midlands Electricity Board, 234 Victoria Rd, Fenton, Stoke-on-Trent.

Wolverhampton Area

SECOND ASSISTANT DISTRICT ENGINEER (CANNOCK)

Duties include the planning, construction, operation and maintenance of H.V. and M.V. mains and substations within the District. Applicants should preferably have had experience in planning and in the commission and maintenance of H.V. switchgear and protection. Technical qualifications desirable. Salary: £1,040/£1,165 per annum (N.J.B. Grade F.7).

THIRD ASSISTANT DISTRICT ENGINEERS (LICHFIELD)

Applicants should have had experience in the construction and maintenance of high and medium voltage distribution systems. Technical qualifications desirable. Salary: £825/£940 per annum (N.J.B. Grade E.9). (The District classification is likely to be raised to Class F, effective 1 April, 1961.)

Apply, by letter, within 14 days, stating age, qualifications, experience, present position and salary to Mr D. Holt, Area Manager, Midlands Electricity Board, 83 Darlington St, Wolverhampton.

Worcestershire Area

THIRD ASSISTANT DISTRICT ENGINEER (REDDITCH/BROMSGROVE)

Applicants should have had a sound technical training and experience in construction, operation and maintenance of overhead and underground distribution systems. Technical qualifications desirable. Salary: £965/£1,090 per annum (N.J.B. Grade G.9).

Apply, by letter, within 14 days, stating age, experience, present position and salary, to Mr E. B. Willis, District Manager, Midlands Electricity Board, Windsor Rd, Redditch, Worcs.

SECOND ASSISTANT DISTRICT COMMERCIAL ENGINEER (WORCESTER AND MALVERN)

Applicants should have had experience in the industrial and domestic aspects of commercial work, including installations and sales and service to the consumer. Technical qualifications desirable. Salary: £965/£1,090 per annum (N.J.B. Grade F.8).

THIRD ASSISTANT DISTRICT COMMERCIAL ENGINEER (WORCESTER AND MALVERN)

The successful applicants will be required to advise consumers with regard to all commercial activities of the Board. Duties will include preparation of estimates for wiring installations of all types and the supervision of contracting and sales work. Salary: £825/£940 per annum (N.J.B. Grade F.10).

Apply, by letter, within 14 days, stating age, experience, present position and salary, to District Manager, Midlands Electricity Board, P.O. Box No. 16, Blackpole Rd, Worcester. (B 103)

SOUTH OF SCOTLAND ELECTRICITY BOARD
Fife Area
SECOND ASSISTANT ENGINEER
(METER, TEST AND PROTECTION)

APPLICATIONS are invited for this post at Area Headquarters, Dunfermline. Candidates should have had a sound technical training and preferably hold qualifications leading to corporate membership of the I.E.E. N.J.B. conditions and salary, Class J, Grade 7 (Scale 11), £1,275/£1,410 p.a; post superannuable, subject to satisfactory evidence of health.

Applications, on standard form, obtainable from Area Manager, S.S.E.B., East Port, Dunfermline, should be returned not later than 17 June, 1961. (B 79)

THE NORTH WESTERN ELECTRICITY BOARD
PRINCIPAL ASSISTANT (COMMERCIAL)
SUB-AREA COMMERCIAL DEPARTMENT
MANCHESTER

DUTIES include assisting in the general organisation of sales activities in the Sub-Area, particularly relating to domestic and commercial consumers. Applicants should have had a wide experience in the organisation and supervision of service centres; planning sales campaigns; preparation of staff training lectures; interior and window displays and exhibition layouts; preparation and giving of lecture demonstrations to outside organisations, and dealing with all types of correspondence from domestic and commercial consumers. Technical knowledge of appliances and installations will be an advantage.

Salary Scale: £1,250 x £35—£1,355 p.a. Grade 7. N.J.C. Conditions.

Applications on forms to be obtained from the Manager (Staff Vacancy), No. 1 Sub-Area, The North Western Electricity Board, Town Hall, Manchester, P.O. Box 493, and returned to him by 19 June, 1961.

FOURTH ASSISTANT DISTRICT
COMMERCIAL ENGINEER
CHORLEY DISTRICT

The person appointed will be required to assist in the general supervision of the Installation Contracting and Servicing Section in the District. Experience in estimating and design for electrical installation contracts and organisation of servicing, and the supervision of manual workers is essential.

Possession of the H.N.C. in Electrical Engineering will be an advantage.

Salary Scale: £890/£1,015 p.a. Grade H.11. N.J.B. Conditions.

Applications on forms to be obtained from the Manager, No. 4 Sub-Area, The North Western Electricity Board, 40-41 Lune St, Preston, and returned to him by 19 June, 1961.

FOURTH ASSISTANT ENGINEER
(POWER SALES AND CONTRACTING)
SUB-AREA COMMERCIAL DEPARTMENT
BLACKBURN

Applicants should have had experience in the preparation of specifications and estimates for large industrial power, lighting and heating installations, including power factor correction schemes. A knowledge of rural development work would be an advantage. Preference given to applicants who hold the H.N.C. in Electrical Engineering.

Salary Scale: £965/£1,090 p.a. Grade L.13. N.J.B. Conditions.

Applications on forms to be obtained from the Manager, No. 5 Sub-Area, The North Western Electricity Board, Jubilee St, Blackburn, and returned to him by 19 June, 1961. (B 76)

CENTRAL ELECTRICITY GENERATING BOARD
Midlands Region
West Midlands Division
GENERAL ASSISTANT ENGINEER

REQUIRED at Walsall Power Station. N.J.B. service conditions, superannuable appointment, salary within Schedule A, J.14, £765/£870 per annum.

Applicants should have received a sound technical training in power station engineering and possess appropriate technical qualifications.

Apply, quoting Vacancy No. 150/61 MD., on form AE6, available from the Station Superintendent, Walsall Power Station, Reedswood La, Birchills, Walsall, Staffs, to whom they should be returned to arrive by 19 June, 1961. (B 96)

J. & P.

TRANSFORMER DESIGN ENGINEERS required for SOUTH AFRICA

Johnson and Phillips wish to engage a senior power transformer design engineer with experience embracing units up to 88 kV rating, for their new Transformer factory situated about 12 miles from Johannesburg. For applicants who respond promptly, interviews can be arranged with the Managing Director of Johnson and Phillips South Africa (Pty) Ltd., who will be in London until 30 June.

Applications, which will be treated in strict confidence, should, in the first instance, be addressed to the Director and General Manager, Johnson and Phillips Ltd., Charlton, London S.E.7. (B 93)

BRUSH

Brush Electrical Engineering Company Limited
(A member of the Hawker Siddeley Group—Industrial Division)

DRAUGHTSMEN

Transformer
Switchgear
Rotating Electrical Machines
Motor Control Gear
Electric and Diesel Electric Locomotives
(Mechanical, Control Gear & Electrical Machines)
General Engineering

If you are a qualified Draughtsman and interested in one of the above vacancies, please apply to:

Mr. A. Garner,
Brush Electrical Engineering Company Limited,
Loughborough, Leicestershire,

quoting reference PL.9943, and giving brief details of your qualifications and experience.

ALL APPLICATIONS WILL BE TREATED IN THE STRICTEST CONFIDENCE.

The Company is situated in a small town on the edge of Charnwood Forest. Extensive housing development is taking place and excellent educational facilities of all grades are available. (B 25)

ENGLISH ELECTRIC—CONTROL ENGINEERING

TECHNICAL SALES ENGINEERS

are required to join the expanding Sales organisation of the Control Gear Division. Applicants should be of H.N.C. standard but, in certain circumstances, applications will be considered from those studying for this qualification. A knowledge of A.C. and D.C. machine control would be an advantage. Technical Sales Engineers will be based at Kidsgrove Works and be expected in due course to assist Branch Sales Engineers in putting forward specialised schemes to the Company's customers anywhere in the U.K. while Works' activities include the preparation of tenders for such control schemes and drives.

This Division of the Company is utilising the latest techniques in the control of variable and constant speed drives and the application of contactless switching devices to industrial control schemes. These posts offer an excellent opportunity to gain experience in these new fields and provide an interesting and progressive career in Sales Engineering.

Applications should be sent to: Mr. G. M. Smith, Dept. G.P.S., English Electric House, Strand, London W.C.2, quoting reference number ET397A. (B 92)

SOUTH EASTERN ELECTRICITY BOARD
ASSISTANT DISTRICT ENGINEER
CENTRAL SUSSEX DISTRICT

SALARY: £965/£1,090 per annum under N.J.B. Class F, Grade 8. Superannuable. Applicants should be suitably qualified and have had training and experience in the construction, operation and maintenance of underground and overhead distribution systems.

The District is 198 sq miles in area and the units sold in 1960-61 were 199 millions. It is expected that the District classification will be raised to G in one or two years' time.

Transport will be provided or the successful candidate may elect to use his own car on Board's business with the appropriate allowance. A service tenancy of a Board's flat will be offered.

Applications, quoting ET and naming two referees, to the District Manager, Seeboard, Electra Hse, Church Rd, Haywards Heath, by 21 June, 1961.

GEORGE WRAY,
Secretary.
(B 120)

CENTRAL ELECTRICITY GENERATING BOARD
Midlands Region
West Midlands Division
ASSISTANT MAINTENANCE ENGINEER
(MECHANICAL)

REQUIRED at Rugeley Power Station, Rugeley, Staffs. N.J.B. service conditions, superannuable appointment. Salary according to Class L, Grade 8, Scale 12, £1,350/£1,500 per annum.

Applicants should have served an apprenticeship and preferably possess technical qualifications of H.N.C. level or leading to corporate membership of a major engineering institution. Wide practical experience of mechanical maintenance at a modern power station is essential.

Applicants who have previously applied for this position will be reconsidered and need not re-apply.

Apply, quoting vacancy no. 158/61MD, on form AE6, available from the Station Superintendent, Rugeley Power Station, Rugeley, Staffs, to whom they should be returned by 19 June, 1961. (B 114)

EASTERN ELECTRICITY BOARD
Fens Sub-Area
ARCHITECTURAL DRAUGHTSMAN
SUB-AREA HEADQUARTERS

A VACANCY exists for an Architectural Draughtsman in the Fens Sub-Area drawing office at Milton Hall, Cambridge.

Applicants should have undergone a thorough training, preferably in an architect's office, and have reached the Inter. R.I.B.A. standard. An opportunity to continue with studies by way of part-time release would be given in suitable cases.

Salary: N.J.B. Class K, Grade 15 (£765/£870).

Apply by letter with details of age and experience to the Manager, Fens Sub-Area, Eastern Electricity Board, Milton Hall, Milton, Cambridge, by 23 June, 1961. (B 127)

SURREY EDUCATION COMMITTEE
CARSHALTON TECHNICAL INSTITUTE
NIGHTINGALE RD, CARSHALTON

REQUIRED 1 Sept., 1961:
TWO ASSISTANTS

One Grade B, to teach electrical subjects, drawing and mathematics to students preparing for C. and G. of London Institute Electrical Technicians' examinations; and one Grade A for C. and G. Electrical Installation and Electrical Fitters' Courses.

Salary: Burnham Technical Scales, 1959, Grade B, £700 x £27 10s—£1,150; Grade A, £520 x £27 10s—£1,000. Commencing salary according to qualifications and experience.

Applications in writing, to Principal, giving full details of qualifications, trade and teaching experience, and two referees, within 14 days of date of advertisement. (B 118)

CENTRAL ELECTRICITY GENERATING BOARD
Midlands Project Group
SENIOR ASSISTANT ENGINEER
(MECHANICAL)

APPLICATIONS are invited for the appointment of Senior Assistant Engineer (Mechanical) at Sizewell "A" Nuclear Power Station site, Suffolk.

Applicants should have considerable experience in the construction and testing of heavy plant as installed in modern power stations, and should preferably be corporate members of the Institution of Mechanical Engineers.

The salary for this appointment will be within Grade 2, Scale 18, of the National Joint Board Agreement, i.e., £1,820/£2,235 per annum.

Applications should be submitted to the Administrative Officer, Midlands Project Group, P.O. Box No. 314, Birmingham 30, not later than 19 June, 1961.

Envelopes should be marked "Confidential —Staff Vacancy No. MPG.40/61." (B 77)

CENTRAL ELECTRICITY GENERATING BOARD
South Thames Division
ELECTRICAL ENGINEER'S DEPARTMENT
CROYDON DISTRICT
THIRD ASSISTANT ENGINEER (GRADE 6)
Vacancy No. 162/61.

TO take charge of all transmission, operation and maintenance work in the Croydon District (Power) in the Electrical Engineer's Department. Applicants should be Associate Members of the Institution of Electrical Engineers or have qualifications leading to Associate Membership and should have had wide experience of overhead line, substation and cable operation and maintenance practice at 275 kV and 132 kV, and of administration and control of staff.

Salary: N.J.B. Class AX (under review), Grade 6, £1,355/£1,550 per annum, including London Allowance.

Applications, giving age, details of experience, qualifications, etc., should be sent to the Personnel Officer, Central Electricity Hse, Lower Ham Rd, Kingston upon Thames, Surrey, to arrive by 19 June. (B 116)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD
SENIOR SERVICE CENTRE ASSISTANT

REQUIRED at Whitchurch. Salary within the range £600/£700 per annum (N.J.C. Grade 1).

Applications are invited from candidates who have personality and an enthusiasm for selling to take control of a modern Electricity Service Centre in a thriving market town.

Ability to sell electrical appliances, arrange window displays, give advice to consumers and receipt accounts is essential.

Appointment subject to medical examination. Pension scheme.

Standard application forms obtainable from the Manager, No. 4 Sub-Area, Electricity Hse, Rhostyllen, nr. Wrexham, or from any District Office.

Closing date: 21 June, 1961.

Previous applications remain under consideration. (B 112)

KENT EDUCATION COMMITTEE
Gravesend Technical College

APPLICATIONS are invited from suitably qualified persons for the following full-time appointment to commence from 1 Sept., 1961:—

ASSISTANT LECTURER, GRADE A,
for Engineering Science and Drawing, Trade Calculations and ability to instruct in Mechanical or Electrical Workshop Practice.

Salary: Burnham Technical (under review) £520 x £27—£40 to £1,000.

Application forms and further particulars from the Principal, Technical College, Darnley Rd, Gravesend. (B 132)

Box No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2

ASSISTANT ELECTRICAL ENGINEERS with at least H.N.C. and 2/3 years' experience of E.H.V. Transmission Work, required by Consulting Engineers in their Contracts and Design Department, Weybridge. Applications stating age, qualifications, experience and salary required, to Kennedy and Donkin, 12 Caxton St, London S.W.1, quoting ref.: RWMc. (B 90)

ARMATURE WINDERS. Opportunity exists for skilled men for general repairs and rewinds. Expanding dept. of old-established electrical engineers. Pension scheme.—Cox-Walkers Ltd., Feethams, Darlington. (B 101)

BRITISH Engine Boiler and Electrical Insurance Co. Ltd., Longridge Hse, Manchester 4. ELECTRICAL SURVEYOR required. Permanent position carrying progressive salary scale £825/£1,225 with non-contributory pension. Candidates aged 26 to 32, with H.N.C. in Electrical Engineering or Grad. I.E.E. and with apprenticeship in manufacture or repair of electrical machinery, are invited to apply stating age, qualifications and experience. (B 89)

CABLE ESTIMATOR required. State age and experience.—Wandleside Cable Works Ltd., 106 Garratt La, Wandsworth, S.W.18. (B 28)

COST ACCOUNTANT for preparation final accounts. Extensive experience electrical contracting invoicing essential. Good salary, pension, housing available. J. W. Russell Ltd., 18 Queen's Rd, Watford. (B 134)

DRAUGHTSMAN required for interesting work on latest methods of Electrical Switchboard construction, utilising moulded-case circuit-breakers. Preferably aged 23-25, having some previous experience of switchboard design, and capable of working with minimum of supervision.

Opportunities of advancement, good working conditions and canteen facilities.

At least A.E.S.D. rates for right man.

Apply by letter to: The Secretary, J. A. Crabtree and Co. Ltd., Lincoln Wks, Walsall. (B 105)

ESTIMATOR required. Experienced in Wood Pole Overhead Line Work. Details and salary required. Ref. JHP.—B. French Ltd., Pike Mills, Kidderminster. (B 88)

ELECTRICAL CONTRACTS ENGINEER required for Circuit-Breaker Sales Office. This is a rapidly growing division of our Company, and appointment will offer wide opportunities for advancement.

Successful applicant preferably should have H.N.C. (Elec.), but previous experience is not essential. Far more important is ability to work quickly and efficiently with minimum of supervision. Duties include drawing up of quotations and dealing with written or telephone queries of a technical nature. Excellent working conditions and canteen facilities.

Good salary, depending upon qualifications and experience.

Apply by letter to: The Secretary, J. A. Crabtree and Co. Ltd, Lincoln Wks, Walsall. (B 107)

ELECTRICAL DRAUGHTSMAN required by the Guest Keen Iron and Steel Works (Branch of G.K.N. Steel Co. Ltd.), aged 25-30. Applicants should be of H.N.C. standard and have a knowledge of heavy industrial plant. Salary dependent on age and experience. Superannuation scheme, canteen and sports club facilities. Applications in writing to the Labour Manager, Guest Keen Iron and Steel Works, East Moors, Cardiff. (B 35)

INDEPENDENT Cable Manufacturers require REPRESENTATIVE for the London area. This is a good opening for a suitable man and fullest particulars should be submitted in the first instance, all details being treated with the strictest confidence.—Box No. 8321, Electrical Times. (B 94)

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LIGHTING SALES ENGINEER. Experienced man having proven sales record and good connection with users, architects and consultants required in East Midlands area. Short period of training will be given at head office in London, and successful candidate should have some technical experience. I.E.S. Diploma membership advantageous. An opportunity for a youngish man to build his future in a happy old-established organisation. Car provided and expenses. Contributory Pension Fund. Apply, with full details of experience, etc. (marking envelope "Confidential"), to Box No. 8319, Electrical Times. (B 75)

PROTECTION ENGINEER required for the design and operation of the electrical system of The Saskatchewan Power Corporation, Canada. Associate Member of the Institution of Electrical Engineers or equivalent. Commencing salary range $614/$704 per month. Please write giving full details of qualifications and experience to Personnel Officer, Ewbank & Partners Ltd., 11 Grosvenor Pl, London S.W.1. (B 59)

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NOTICE is hereby given that Simplex Electric Company Limited seeks leave to amend the Complete Specification of the Application for Letters Patent No. 818,371 for an invention entitled "Improvements relating to means for controlling the power dissipation in electric heaters."

Particulars of the proposed amendments were set forth in the Official Journal (Patents), No. 3,773, dated 7 June, 1961.

Any person may give Notice of Opposition to the amendment by leaving Patents Form No. 36 at the Patent Office, 25 Southampton Bldgs, London W.C.2, on or before 7 July, 1961. (B 126)

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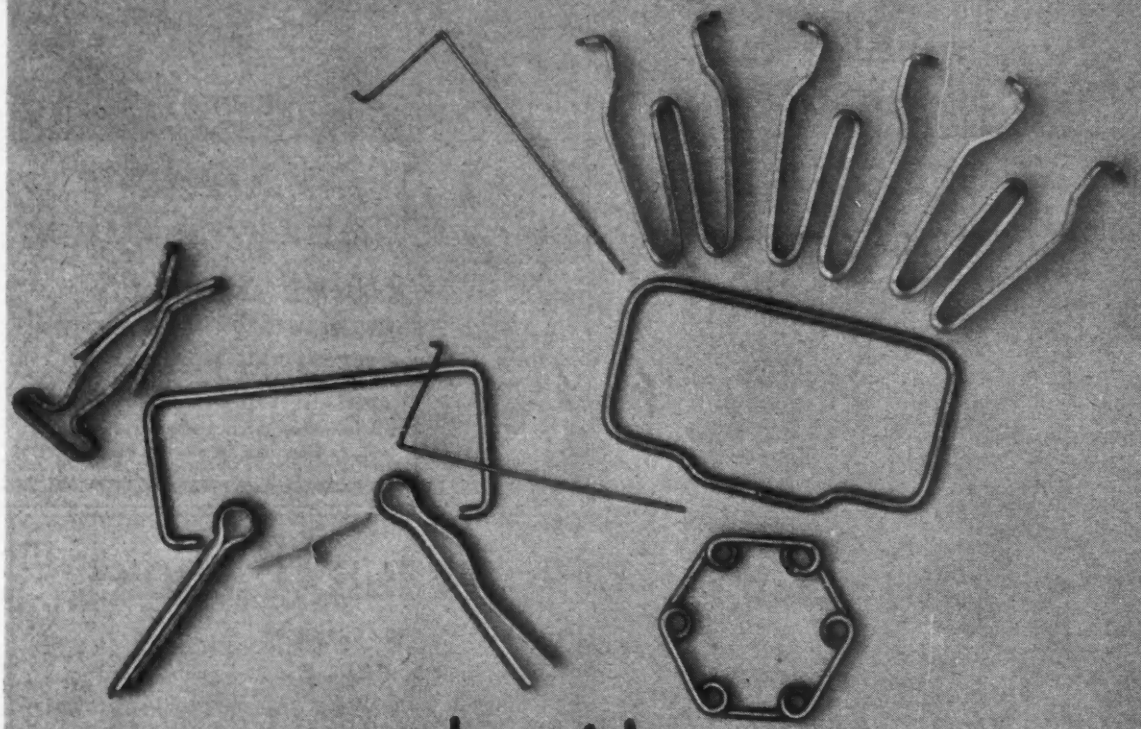

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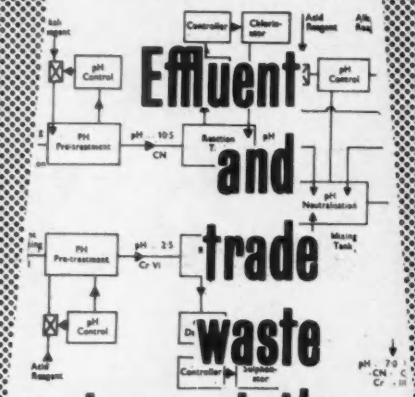

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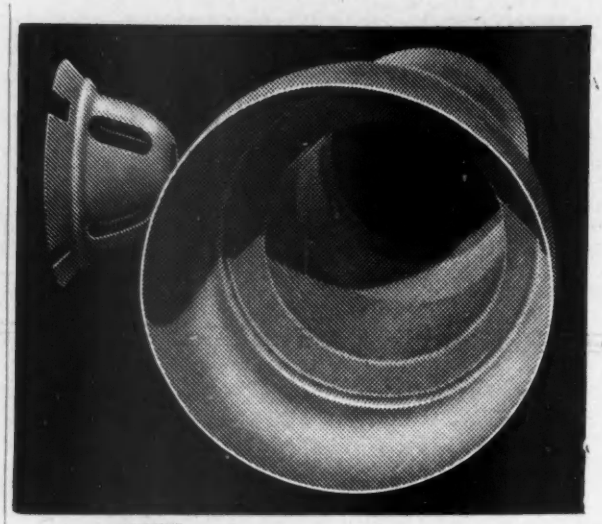

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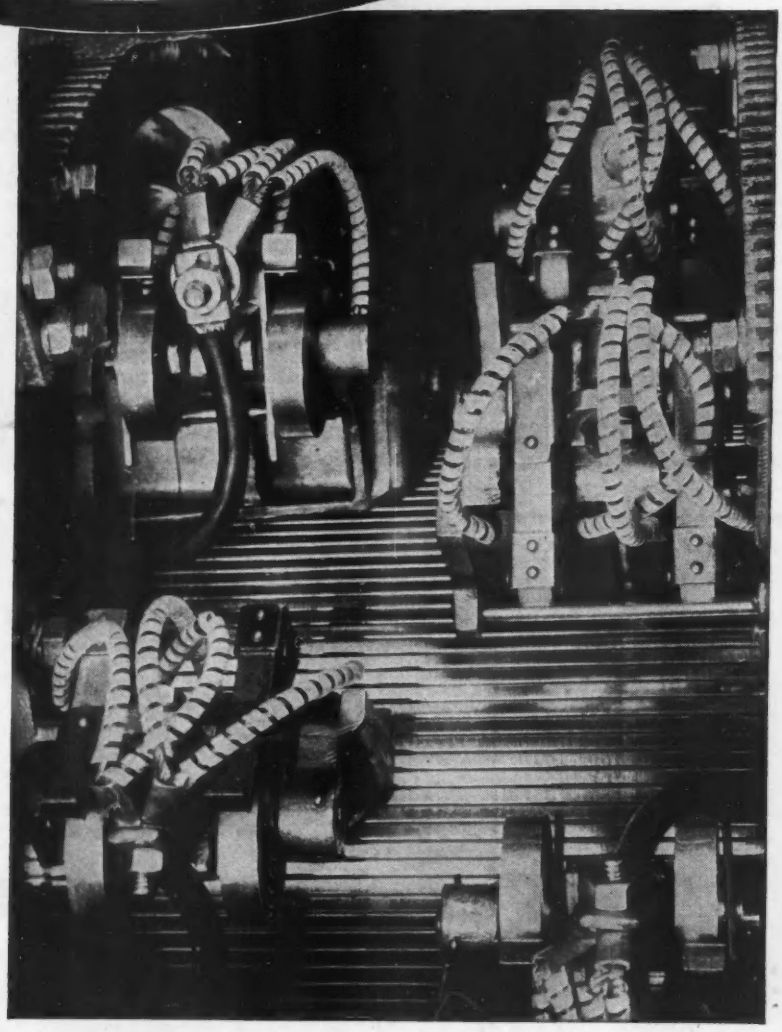

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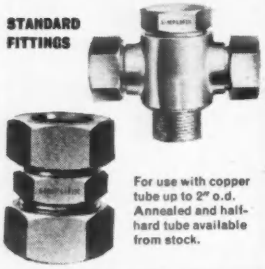

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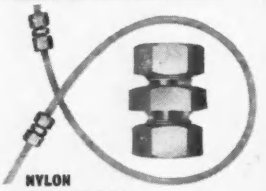

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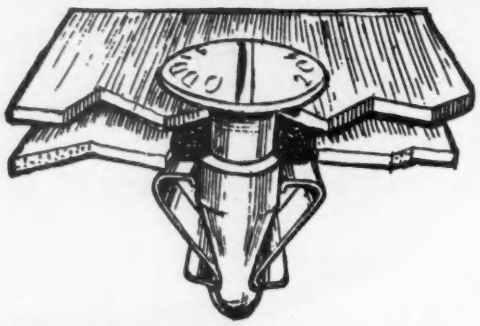

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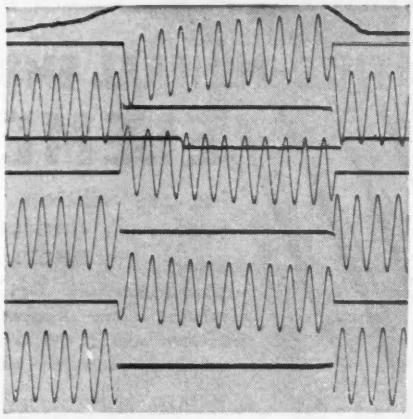

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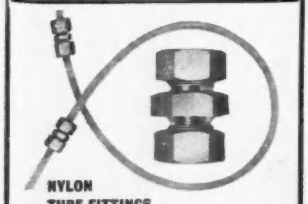
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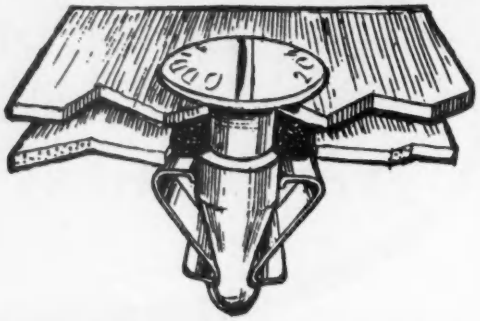

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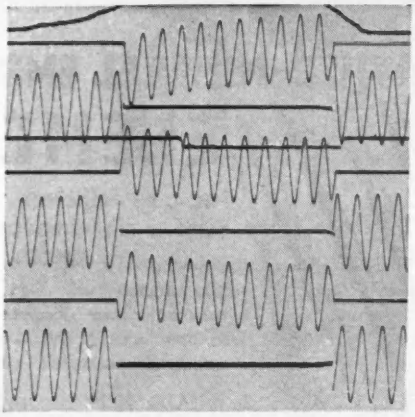

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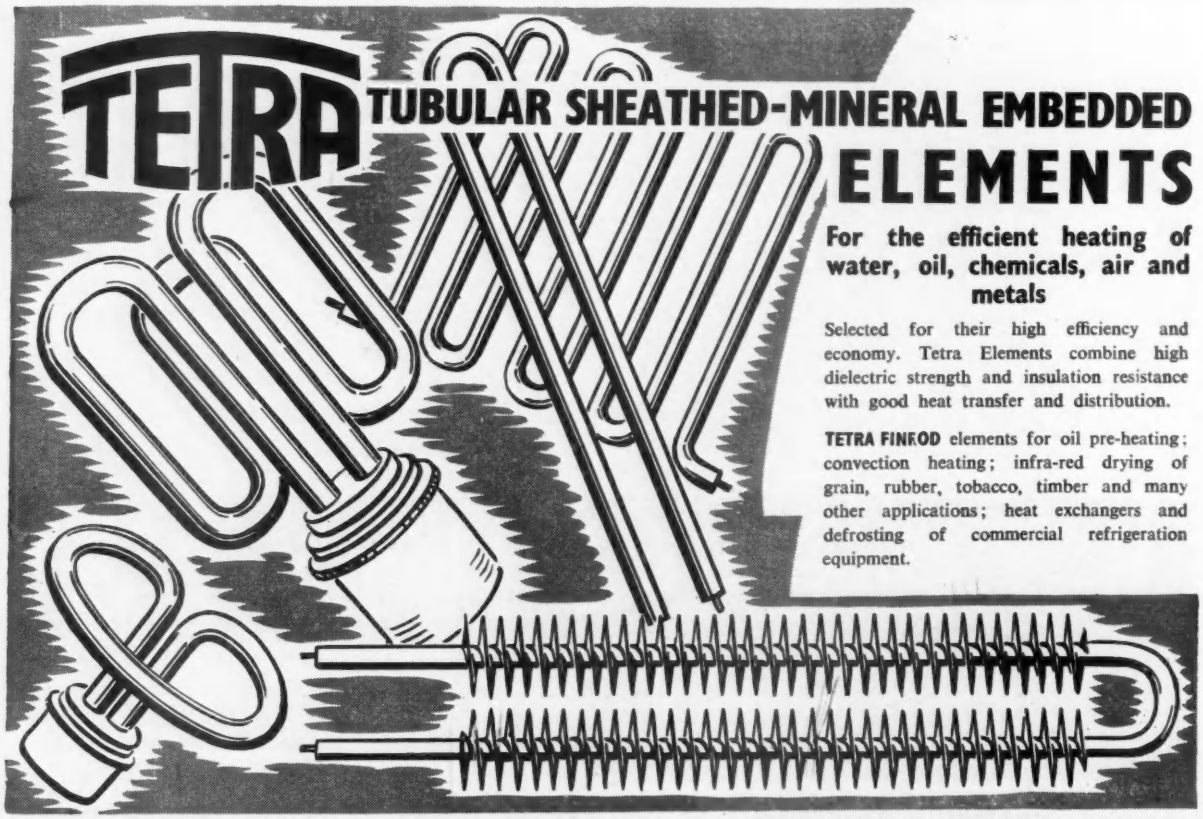

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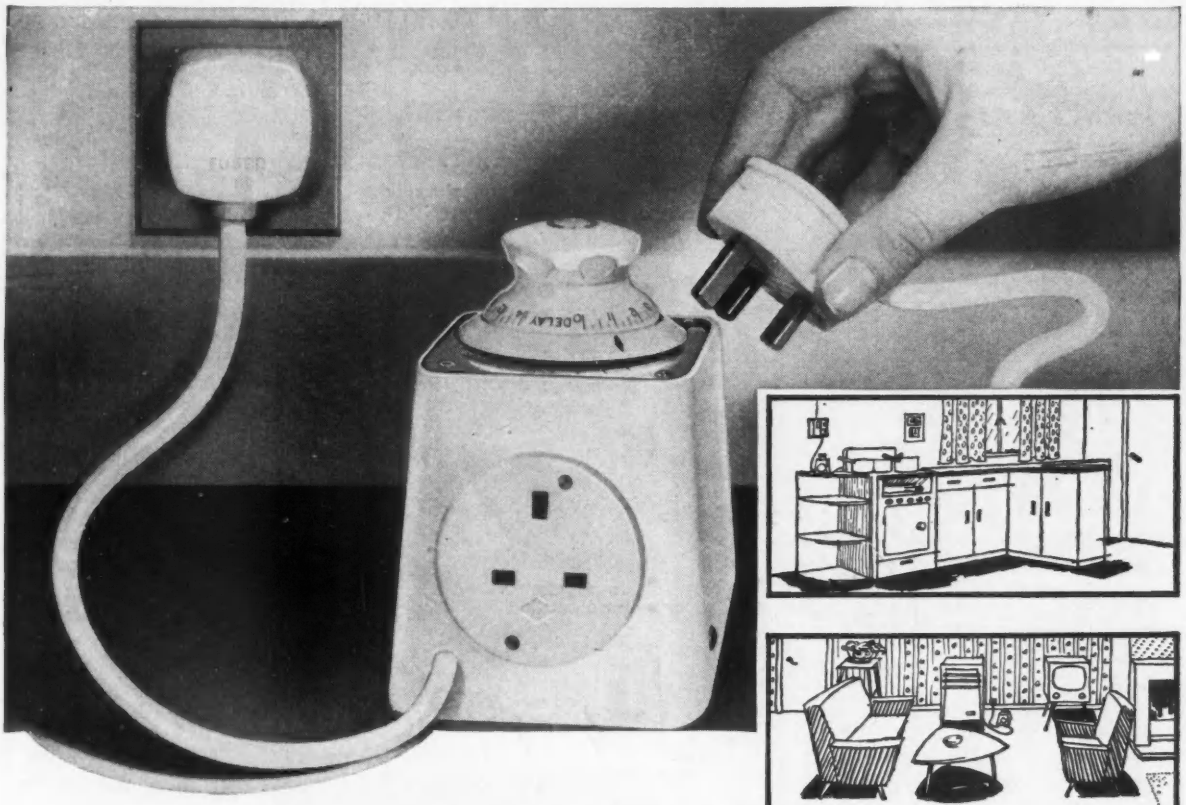

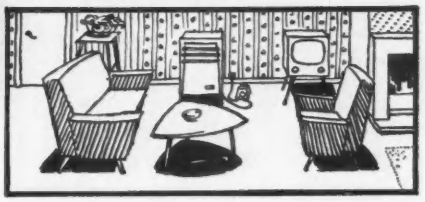

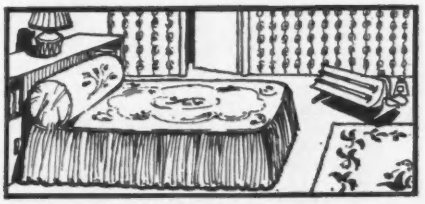

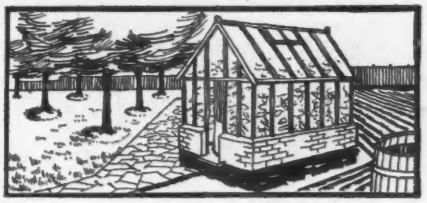

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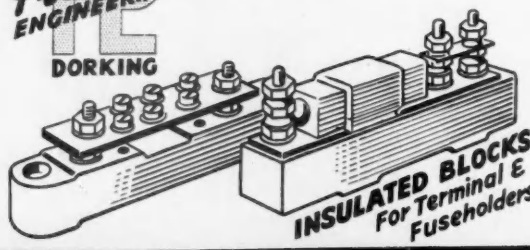

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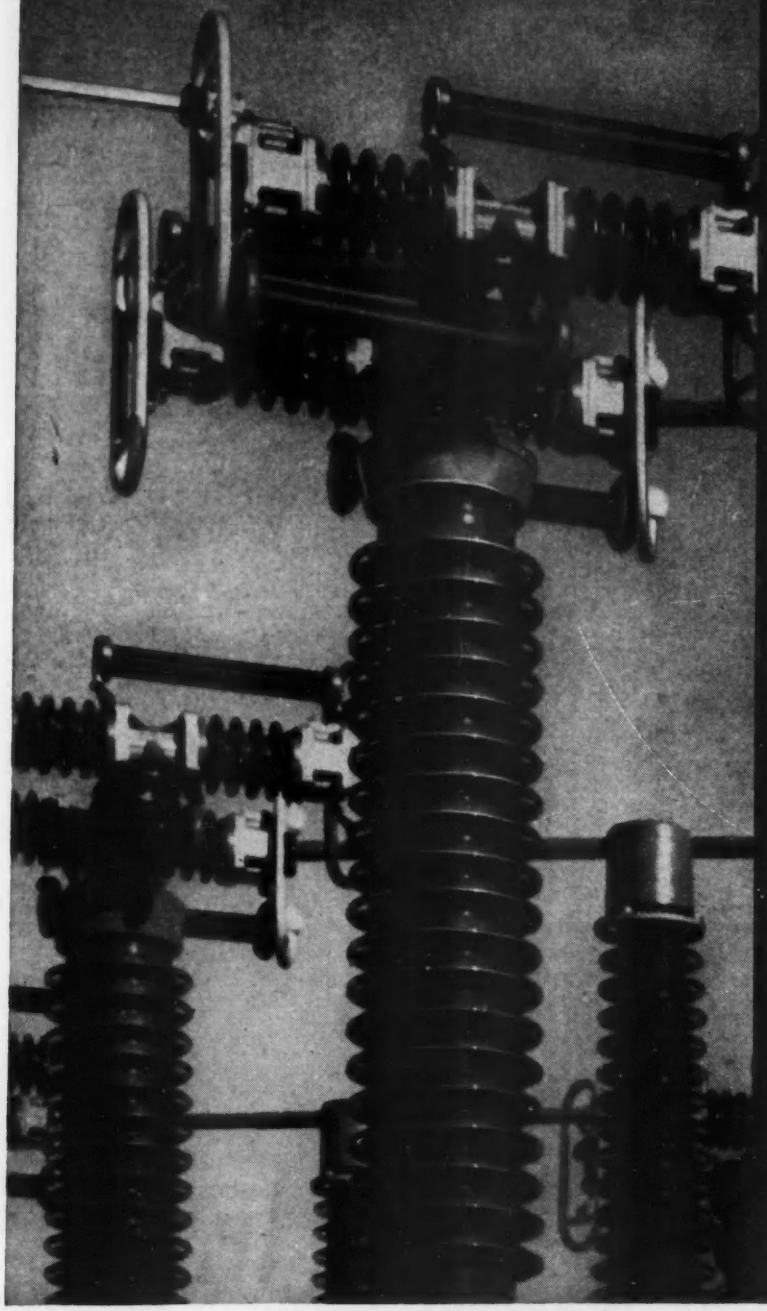

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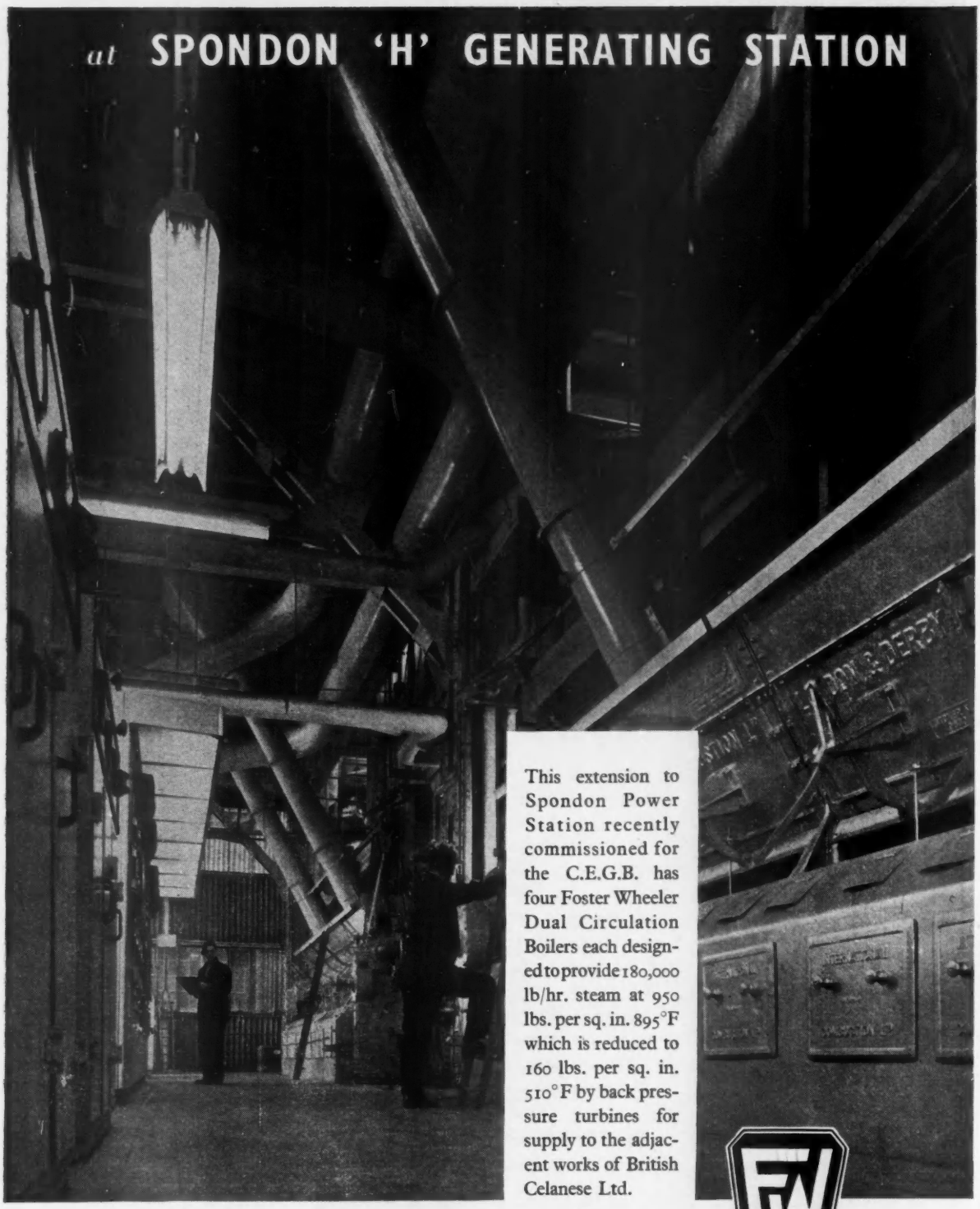
FOSTER WHEELER DUAL CIRCULATION BOILERS

at SPONDON 'H' GENERATING STATION



This extension to Spondon Power Station recently commissioned for the C.E.G.B. has four Foster Wheeler Dual Circulation Boilers each designed to provide 180,000 lb/hr. steam at 950 lbs. per sq. in. 895°F which is reduced to 160 lbs. per sq. in. 510°F by back pressure turbines for supply to the adjacent works of British Celanese Ltd.

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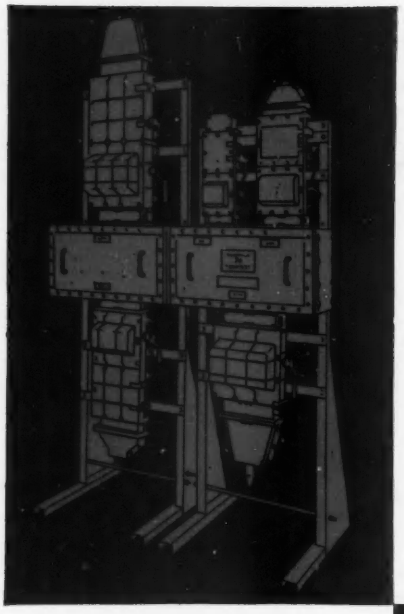

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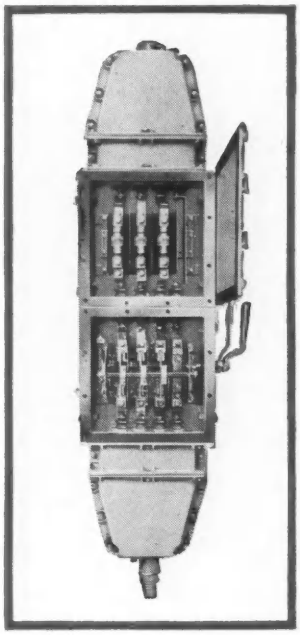

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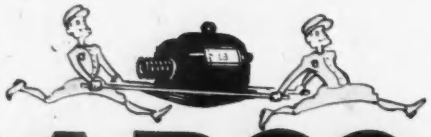

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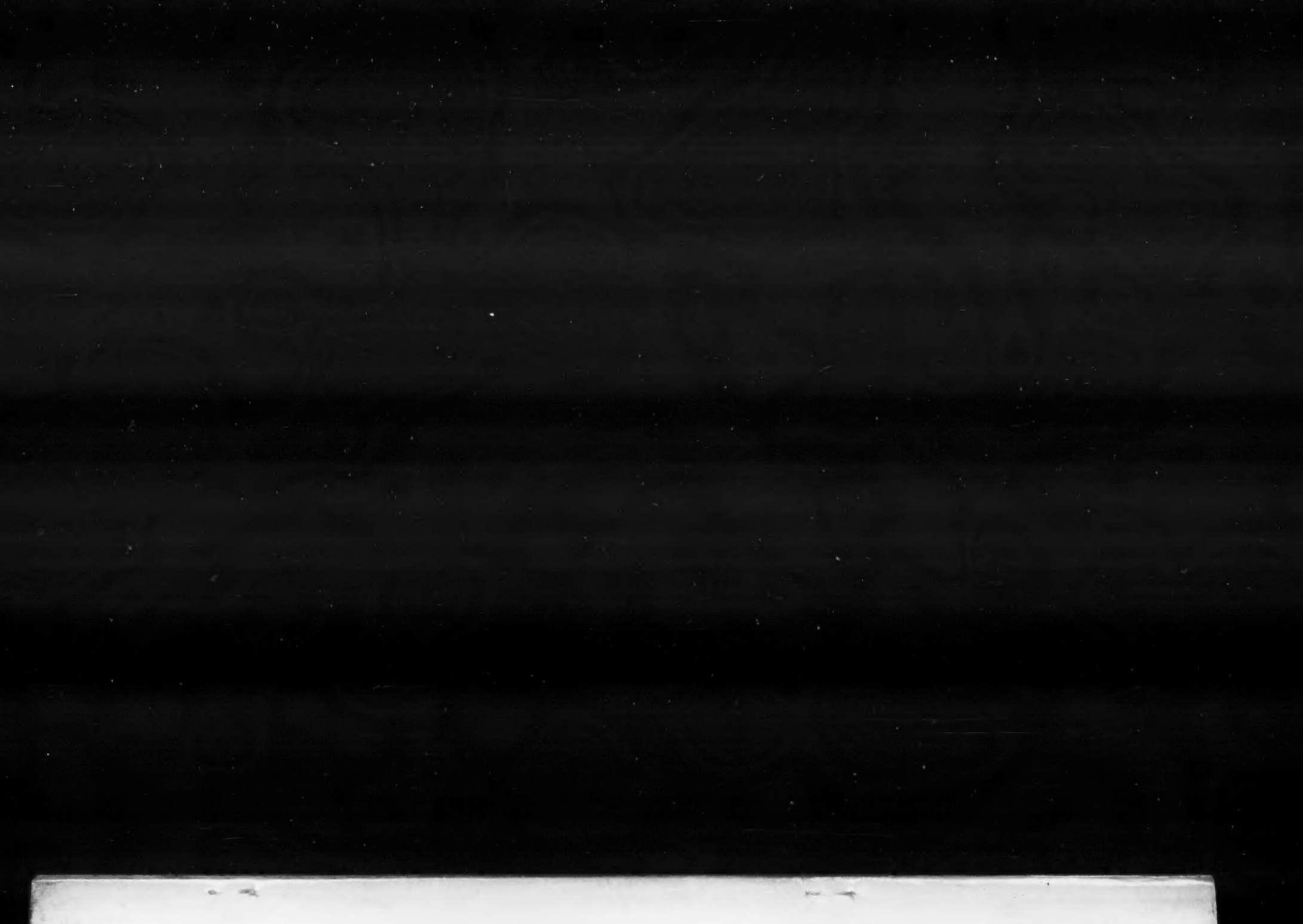
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